Ontario Geological Survey

Report 205

Geology of the

Grey Owl Lake Area

District of Algoma

By

E.C. Grunsky

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1981

Ontario
Ministry of Natural Resources

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Printed in Canada

ISSN 0704-2582
ISBN 7743-5049-0

Publications of the Ontario Ministry of Natural Resources
and price list are obtainable through the
Ministry of Natural Resources, Public Service Centre
Room 1640, Whitney Block, Queen's Park, Toronto,
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Grunsky, E.C.
1981: Geology of the Grey Owl Lake Area, District of Algoma; Ontario Geological Report 205, 76p. Accompanied by Map 2446, Scale 1:31 680 (1 inch to ½ mile).

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CONTENTS

PAGE

Abstract vii
Introduction 1
Access 1
Mapping Method 2
Acknowledgments 2
Previous Work 3
Topography and Drainage 3
Natural Resources 4

General Geology 5
Table of Lithologic Units 6
Early Precambrian 8
Metavolcanics and Metasediments 8
Mafic to Intermediate Metavolcanics 8
Fine- to Medium-Grained Hornblende-Plagioclase Schist 11
Medium- to Coarse-Grained Hornblende-Plagioclase Flows, Schist 15
Amphibolites (Gneissic and Migmatitic) 16
Tuff 16
Intermediate Metavolcanic Tuff 16
Pillowed Flows 17
Felsic to Intermediate Metavolcanics 18
Quartz-Plagioclase-Muscovite Schist and Gneiss 19
Tuff 19
Lapilli-Tuff 24
Chemical Metasediments 24
Banded Chert and Magnetite Ironstone 24
Clastic Metasediments 25
Quartz-Plagioclase-Biotite ± Hornblende Schist, and Migmatite Gneiss 26
Wacke and Arkose 27
Siltstone 31
Waterlain and Reworked Metavolcanic Tuffs 31
Graphite and Slate 32
Conglomerate 32
Gritty Wacke and Pebbly Wacke 33
Felsic Intrusive Rocks 34
Foliated Felsic Intrusive Rocks 34
Migmatitic Granitic Rocks 34
Quartz Monzonite, Granodiorite, Trondhjemite 38
Syenodiorite and Tonalite 38
Pegmatite and Aplite 39
Massive Felsic Intrusive Rocks 39
Late Precambrian 41
Mafic Intrusive Rocks 41
Diabase Dikes 41
Cenozoic 44
Quaternary 44
Pleistocene and Recent 44

Metamorphism 44
Structural Geology 47
Faults and Lineaments 54

Correlation of Geology and Geophysics 56
Stratigraphic Synthesis of the Early Precambrian Metavolcanic-Metasedimentary Succession 56

Economic Geology 58
Base Metals 58
Iron 62
Uranium 62
History of Mineral Exploration 63

Descriptions of Occurrences 64
Algoma Central Railway [1962] (1) 64
Mallot Lake - North [1962] 64
Mallot Lake - East 65
Grey Owl Lake 65
Doyle Lake - East 65
McAughey Township - Southeast [1962] 65
Canex Aerial Exploration Limited [1966] (2) 66
Geophysical Engineering Limited [1975] (3) 66
Doyle Lake - East 66
Doyle Lake - South 67
Gimby, J.E. [circa. 1952] (4) 67
Rio Tinto Exploration Limited [1964] (5) 68
Redcliff Lake 68
Doyle Lake - North 69
Doyle Lake - South of the Lakeshore 69
Doyle Lake - South 69
Doyle Lake - South-Southeast 69
Grey Owl Lake - Southeast 70
Doyle Lake Occurrence (6) 70

Recommendations for Future Mineral Exploration 70
References 73

TABLES

1–Table of Lithologic Units for the Grey Owl Lake Area 6

2–Chemical and Modal Analyses of Mafic to Intermediate Metavolcanics 12

3–Chemical and Modal Analyses of Felsic to Intermediate Metavolcanics 20

4–Chemical and Modal Analyses of Metasediments 28

5–Chemical and Modal Analyses of Early Felsic Intrusive Rocks 35

6–Chemical and Modal Analyses of Late Felsic Intrusive Rocks 40

7–Chemical and Modal Analyses of Diabase Dikes 42

8–Summary of Assessment Work in the Grey Owl Lake Area 59

FIGURES

1–Location Map of the Grey Owl Lake Area vii

2–AFM Ternary Diagram of the Grey Owl Lake Metavolcanics and Diabase Dikes 9

3–Jensen Cation Plot of the Grey Owl Lake Metavolcanics and Diabase Dikes 10

4–Generalized Metamorphic Zones in the Grey Owl Lake Area 45

5–Schistosity measurements in the Grey Owl Lake Map-Area 48

6–Bedding measurements in the Grey Owl Lake Map-Aarea 49

7–Gneissosity measurements north of the Montreal River 51

8–Foliation measurements north of the Montreal River 52

9–Joint measurements in the Grey Owl Lake Stock 53

PHOTOGRAPHS

1–Mafic to intermediate tuff with felsic to intermediate lapilli fragments. 1400 m east of Doyle Lake 17

2–Porphyroblasts of hornblende in felsic to intermediate banded tuff. Note the stictolithic hornblende. Doyle Lake 22

3–Banded felsic to intermediate tuff on Doyle Lake. Note the stictolithic hornblende. The dark unit is a mafic to intermediate tuff 23

4–Crystal tuff with plagioclase fragments - 1.2 km NW of Doyle Lake 23

5–Garnetiferous lapilli-tuff. 900 m north of Doyle Lake 24

6–Banded wackes - turbidites, 2.6 km west of Mallot Lake. Note the leucosome developed due to anatectic metamorphism in the upper right corner of the photo 30

7–Oligomictic paraconglomerate composed of felsic metavolcanic fragments in a gritty wacke matrix. 1.6 km east of Alvin Lake 33

8–Metatexite composed of biotite schist and gneiss intruded by a quartz-plagioclase leucosome (mobilizate) along the north shore of the Montreal River 36

9–Inhomogeneous diatexite showing extensive assimilation of a biotite gneiss similar to the one in Photo 8. Jeff Creek Inlet on the Montreal River 37

GEOLOGICAL MAP

(back pocket)

Map 2446 (coloured)–Grey Owl Lake Area, District of Algoma.
Scale 1:31 680 (1 inch to ½ mile).

CONVERSION FACTORS FOR MEASUREMENTS IN ONTARIO GEOLOGICAL SURVEY PUBLICATIONS

If the reader wishes to convert imperial units to SI (metric) units or SI units to imperial units the following multipliers should be used:

CONVERSION FROM SI TO IMPERIAL			CONVERSION FROM IMPERIAL TO SI		
SI Unit	*Multiplied by*	*Gives*	*Imperial Unit*	*Multiplied by*	*Gives*
			LENGTH		
1 mm	0.039 37	inches	1 inch	**25.4**	mm
1 cm	0.393 70	inches	1 inch	**2.54**	cm
1 m	3.280 84	feet	1 foot	**0.304 8**	m
1 m	0.049 709 7	chains	1 chain	20.116 8	m
1 km	0.621 371	miles (statute)	1 mile (statute)	**1.609 344**	km
			AREA		
1 cm^2	0.155 0	square inches	1 square inch	**6.451 6**	cm^2
1 m^2	10.763 9	square feet	1 square foot	**0.092 903 04**	m^2
1 km^2	0.386 10	square miles	1 square mile	2.589 988	km^2
1 ha	2.471 054	acres	1 acre	0.404 685 6	ha
			VOLUME		
1 cm^3	0.061 02	cubic inches	1 cubic inch	**16.387 064**	cm^3
1 m^3	35.314 7	cubic feet	1 cubic foot	0.028 316 85	m^3
1 m^3	1.308 0	cubic yards	1 cubic yard	0.764 555	m^3
			CAPACITY		
1 L	1.759 755	pints	1 pint	0.568 261	L
1 L	0.879 877	quarts	1 quart	1.136 522	L
1 L	0.219 969	gallons	1 gallon	**4.546 090**	L
			MASS		
1 g	0.035 273 96	ounces (avdp)	1 ounce (avdp)	28.349 523	g
1 g	0.032 150 75	ounces (troy)	1 ounce (troy)	**31.103 476 8**	g
1 kg	2.204 62	pounds (avdp)	1 pound (avdp)	**0.453 592 37**	kg
1 kg	0.001 102 3	tons (short)	1 ton (short)	**907.184 74**	kg
1 t	1.102 311	tons (short)	1 ton (short)	**0.907 184 74**	t
1 kg	0.000 984 21	tons (long)	1 ton (long)	**1016.046 908 8**	kg
1 t	0.984 206 5	tons (long)	1 ton (long)	**1.016 046 908 8**	t
			CONCENTRATION		
1 g/t	0.029 166 6	ounce (troy)/ ton (short)	1 ounce (troy)/ ton (short)	34.285 714 2	g/t
1 g/t	0.583 333 33	pennyweights/ ton (short)	1 pennyweight/ ton (short)	1.714 285 7	g/t

OTHER USEFUL CONVERSION FACTORS

1 ounce (troy)/ton (short)	20.0	pennyweights/ton (short)
1 pennyweight/ton (short)	0.05	ounce (troy)/ton (short)

NOTE–Conversion factors which are in bold type are exact. The conversion factors have been taken from or have been derived from factors given in the Metric Practice Guide for the Canadian Mining and Metallurgical Industries published by The Mining Association of Canada in co-operation with the Coal Association of Canada.

ABSTRACT

The report describes the geology, structure, stratigraphy, and mineral occurrences of parts of Loach, McAughey, McParland, Raaflaub, Runnalls, and Running Townships which cover 250 km^2 in the District of Algoma, approximately 90 km north of Sault Ste. Marie.

The area consists of an Early Precambrian (Archean) metavolcanic-metasedimentary supracrustal succession that has been deformed, metamorphosed, and intruded by two distinct felsic intrusive events. Faulting occurred and diabase dike swarms were emplaced at the time of the development of the Lake Superior Basin and the Kapuskasing Structural Zone. The area was glaciated during the Pleistocene Epoch.

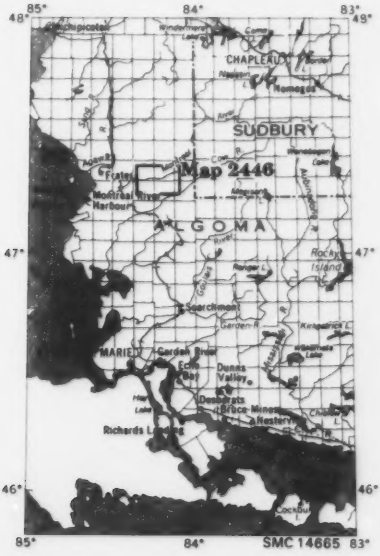

Figure 1–Key Map of the Grey Owl Lake Area. Scale 1:3 168 000.

The supracrustal succession in the map-area is interpreted to be a lower mafic to intermediate metavolcanic sequence of flows and tuffs that are overlain by felsic to intermediate tuffs in the southeast which grade into, and are overlain by, clastic metasediments toward the west part of the map-area. The west part of the map-area has undergone some degree of tectonic mobilization, faulting, and partial anatexis making correlation across the Grey Owl Lake Fault difficult. The felsic metavolcanics are mainly tuffaceous in origin and appear to be part of a distal facies environment that grades into deep waterlain tuffs and interbedded clastic metasediments. The boundary between the waterlain felsic metavolcanic tuffs and the reworked tuffs and metasediments of similar mineralogy and composition is somewhat arbitrary. This is because of the gradational nature of the boundary between a volcanic and a sedimentary environment. The clastic metasediments consist of wacke, arkose, turbidite, conglomerate, and minor pelitic interbeds. The conglomerates and turbidites are interbedded and probably are deposits formed in a deep basin submarine environment.

The supracrustal rocks have been intruded and assimilated by felsic intrusive rocks that are predominantly foliated trondhjemite and granodiorite. These rocks show progressive anatexis, and are metatexitic to diatexitic migmatites north of the Montreal River and in the southwest part of the map-area. Later massive quartz monzonite stocks have intruded the rocks in the Grey Owl Lake and Doyle Lake areas, and display discordant contacts.

Metamorphism varies from low grade greenschist facies in the southeast, to upper amphibolite facies in the west-central part of the area and along the shore of the Montreal River. The central part of the area, south of the Montreal River, varies from upper greenschist to lower amphibolite facies. Hornblende hornfels facies contact metamorphism occurs around the later quartz monzonite stocks. Schistose textures are common in rocks up to lower amphibolite grade, and gneissic textures predominate in rocks of higher metamorphic grade.

Bedding tops are uncommon. However, of the few measurements observed, the metasediments are indicated to be the youngest and the mafic to intermediate metavolcanics are indicated to be the oldest rocks in the area. The supracrustal rocks form a broad band around the Grey Owl Pluton from the east to the west. On the west side of the pluton, the Grey Owl Lake Fault terminates the sequence and has a sinistral offset of 2000 m. Based on indirect evidence, the Alvin Lake Synform is most probably a syncline, and is probably the western extension of the metavolcanics and conglomerates occurring in the Mallot Lake area.

Diabase dike swarms have intruded fractures and faults that probably developed during Late Precambrian times. Fractures and faults trend at N30°W and N40°E. The largest fault is the Montreal River Fault, which trends east-west to N40°E. This fault is an extension of the southern boundary of the Kapuskasing Structural Zone and extends southwesterly into the Lake Superior Basin.

Numerous small syngenetic sulphide occurrences occur within the felsic to intermediate metavolcanic tuffs in the Doyle Lake area. Units of banded chert and magnetite ironstone occur in the east part of the map-area, and also occur east of Mallot Lake. Additional sulphide occurrences may exist near the contact between the mafic and felsic metavolcanics or further east in Running Township where felsic to intermediate metavolcanics are common. A uranium occurrence exists along the north side of the Montreal River. The occurrence has received only minor attention and additional work is justified here. Late Precambrian related deposits may occur north or west of the map-area.

Geology of the

Grey Owl Lake Area

District of Algoma

By

E.C. Grunsky[1]

INTRODUCTION

The Grey Owl Lake area, located in the District of Algoma, is bounded by Longitudes 84°05′00″ to 84°19′00″W and Latitudes 47°15′00″ to 47°22′30″N, and covers parts of Loach, McAughey, McParland, Raaflaub, Runnalls, and Running Townships as is shown in Figure 1. The area covers an area of approximately 250 km^2. The author and assistants mapped the area during the field season of 1978.

Access

The map-area is divided into two regions separated by the east-trending Montreal River reservoir. Access to the map-area is possible via float-equipped aircraft which can land on the Montreal River reservoir, Alvin, and Grey Owl Lakes. Bases for such aircraft are located in Sault Ste. Marie and Batchawana Bay. For access into the smaller lakes such as Doyle, Dyer, Redcliff, and East Lakes, a helicopter may be required. The map-area is also accessible by boat from Montreal Falls at the west end of the Montreal River reservoir which is approximately 11 km west of the western boundary of the map-area. Montreal Falls can be reached via the Algoma Central Railway at Mile 92, or by a private road maintained by the Great Lakes Power Company. The distance is approximately 14.5 km from Highway 17 to Montreal Falls along this road. It is approximately 150 km from Sault Ste. Marie to Montreal Falls via Highway 17, and approximately 90 km by aircraft from Sault Ste. Marie to the centre of the map-area.

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[1]Geologist, Precambrian Section, Ontario Geological Survey, Toronto, Ontario. Manuscript approved for publication by the Chief Geologist, June 12, 1979. This report is published with the permission of E.G. Pye, Director, Ontario Geological Survey, Toronto.

Use of the Montreal River by float-equipped aircraft or boat can be hazardous at times due to the abundance of floating logs that drift along the reservoir. This is a particular problem when easterly winds are present for several days at a time.

Mapping Method

The geological base map was prepared on an FRI (Forest Resources Inventory) base map at a scale of 1:15 840 by the Cartography Section, Division of Lands, Ontario Ministry of Natural Resources. Air photographs of the same scale were supplied by the Division of Forests and were used in the field for recording the geologic data. The data was recorded on transparent overlays superimposed on the air photographs, and was then transferred onto the base-map.

Mapping was carried out by making traverses that were spaced approximately 0.4 km apart. In places where detail was considered essential, the spacing was made closer. The traverses were carried out using a pace and compass technique; however, the traverses were not tied to any survey lines. All outcrops recorded on the overlays have been labelled with a corresponding lithologic code on the final map (Map 2446, back pocket). In the more inaccessible areas, particularly in the felsic intrusive rocks north of the Montreal River, some of the outcrops were interpreted from examination of the air photographs. In this case, the interpreted outcrops have not been subdivided and are labelled as such on Map 2446, back pocket.

Major structural features and regional structural lineaments were observed from the examination of air photographs (scale 1:50 000) obtained from the National Air Photo Library in Ottawa. A set of geological, geophysical, Pleistocene geology, and structural geology maps are also available from the Algoma Central Railway, Division of Lands, in Sault Ste. Marie. These maps aided the author for part of the compilation of the base map.

During the field season, access to traverse starting points and cabins along the Montreal River was by boat. A fixed wing aircraft was used for access into Alvin and Grey Owl Lakes, and a helicopter was required for access into Doyle Lake. A canoe was used in the smaller lakes. Travel time from the centre of the map-area to Montreal Falls using a 25 horsepower motor on an aluminum boat varies from 30 to 45 minutes, depending on the water and wind conditions.

Acknowledgments

The author was ably assisted in the field by J. McCauley, who acted as senior assistant. T. Hart, S. Leppik, and R. Van Steenburgh were junior assistants. J. McCauley mapped about one half of the map-area and assisted the author to interpret the map units and the preliminary map. R. Van Steenburgh did some independant mapping north of the Montreal River and assisted the author with the structural interpretation during the winter of 1978-79.

During the field season, the field crew stayed at a cabin situated along the south shore of the Montreal River north of Mallot Lake. The author wishes to

acknowledge thanks to Mr. and Mrs. Kenneth Bryngelson for the use of the cabin.

During the field season, the field crew received assistance and helpful information from Mr. and Mrs. Bob Dumas of Dam Site Lodge, Montreal Falls, and from Mike Dupuis, superintendent, at the Montreal Falls Power Plant of the Great Lakes Power Company. The author also would like to express thanks to Mr. M. Killiojarvis of the Great Lakes Power Company, Sault Ste. Marie, for allowing the author to gain access to the Montreal River reservoir by using the company's road. Thanks are also due the staff of the Lands and Forests Division of the Algoma Central Railway for access to their records. The author is deeply grateful to Mr. and Mrs. J. Falkins of Trail's End Lodge, Montreal River Harbour, who gave the author and crew much helpful assistance.

Previous Work

Part of the Grey Owl Lake area was mapped by E.S. Moore (1925) who reported that Runnalls Township was underlain by paragneiss and banded metasediments. These rocks are plotted on Map 34d (Moore 1925). During the 1960s, the Algoma Central Railway (ACR) compiled a series of geological, geophysical, Pleistocene geology, and airphoto interpretation maps from surveys carried out to examine the mineral potential of the ACR land grants. These maps are available from the Lands and Forests Division of the Algoma Central Railway Office in Sault Ste. Marie.

The area to the south has been mapped by G.M. Siragusa (1975, 1976, 1978a, 1978b). The Grey Owl Lake area is covered by regional geological maps (Ayres *et al.* 1971a, 1971b; Giblin and Leahy 1967; Giblin, Leahy, and Robertson 1980), Preliminary Map P.302 (Giblin and Leahy 1977) and by Aeromagnetic Map 2203G (Ontario Department of Mines-Geological Survey of Canada 1963). Topographic maps that cover the area are: Michipicoten 41N at a scale of 1:250 000 and Grey Owl Lake 41N/8 at a scale of 1:50 000.

Adjacent areas to the west, north, have not been mapped.

Topography and Drainage

The topography of the Grey Owl Lake map-area is generally a rugged terrain having an average relief of 75 m and a mean elevation of 365 m above sea level. The banks of the Montreal River and the area to the north are exceptionally rugged. The hills are difficult to climb in many places, particularly north of the Montreal River. This type of terrain is typical of the underlying felsic intrusive rocks. North of the Montreal River, the relief is commonly 100 to 150 m with many vertical cliff faces. South of the Montreal River, the area tends to be hummocky, but the larger diabase dikes form high ridges up to 150 m in height. The area to the north and northwest of Grey Owl Lake is flat and tends to be hummocky to swampy in places, this is generally where the underlying supracrustal rocks are metasediments.

Faults, lineaments, and diabase dikes appear to affect the course of many of the waterways in the map-area. North of the Montreal River, the waterways flow in straight courses parallel to the lineaments and faults and flow southward into the Montreal River. None of the waterways except for Jeff Creek are large enough to allow the easy passage of a canoe.

South of the Montreal River, most of the area within 5 km of the southern bank of this river drains into it. This includes the area around Grey Owl Lake. The Alvin Lake and Doyle Lake areas drain southward into the Batchawana river system. Most of the waterways are fast moving because of the high and variable relief. This relief exists particularly near the bank of the Montreal River and in the north part of the map-area. Nevertheless, because many of the streams, are narrow and short, they are not difficult to cross by foot.

The Montreal River itself is a large reservoir that was created for the purpose of a hydro-electric generating plant at Montreal Falls. The water level on the reservoir can fluctuate by as much as 15 m over a year, and is dependant upon the yearly precipitation. Access into the map-area may be affected, particularly near the eastern boundary of the map-area, by this variation in water level.

The rugged hills are usually sparsely covered by vegetation on their sides, but are covered by sugar maple groves at their summits. The areas of lower relief commonly have sparsely distributed outcrops and have abundant vegetation.

Outcrop exposure varies from less than 5 percent north and northwest of Grey Owl Lake to 50 percent along the bank of the Montreal River. The northwest part of the map-area has been burned over and outcrop exposure in this area is as high as 50 percent. Outcrop exposure in the Alvin, Grey Owl, and Doyle Lakes area varies from 5 to 30 percent. North of the Montreal River, in the central part of the map-area, the outcrop exposure is 5 to 10 percent of the surface area. Much of this is heavily wooded with deciduous forest cover.

Natural Resources

The lakes in the map-area are generally shallow to swampy and are filled with organic debris. Most of the shorelines are littered with glacial boulder debris. Fish do not appear to be in great abundance in most of the lakes except for Alvin Lake and the Montreal River. The Montreal River reservoir is visited by many tourists for its scenery and for the fishing camps that occur along it.

Wildlife is more abundant south of the Montreal River because much of the north side has been burned over. Moose, beaver, rabbit, squirrel, and chipmunk were observed during the field season. Moose were observed on several occasions. The black bear was not observed at any time during the field season. Several sightings of black bears, however, were reported by tourists and lodge owners further to the east.

Fires have occurred throughout the map-area, but have affected particularly its northwest, northeast, and southeast parts. North of the Montreal River, the fire damage has been severe and the vegetation is scrubby. Southeast of Doyle Lake, scrubby bush occurs, covering an area that may have been burned

over many years ago. Traversing in the burned over areas can be difficult.

White pine and yellow birch were cut for commercial use south of the Montreal River. Currently, white pine is being cut north of Doyle Lake. White pine is also common along the banks of the Montreal River and in areas where the relief varies greatly. Old lumber roads occur south of the Montreal River. However, they are not usable except as winter roads. North of Doyle Lake, some skid roads were made recently. They are useful only as winter roads because no road access exists into this area. Maple is the most common deciduous tree and forms large open canopies on the higher ground in the map-area. Black spruce is common in the lower swampy areas.

Sources of sand and gravel are common along the Montreal River in varying degrees of quality. Within the map-area, the most abundant source of gravel that was observed by the author occurs towards the eastern margin of the map-area to the south of the Montreal River.

There are no mines which have operated in the past or present in the map-area.

Base metals, iron, and building stone resources are discussed under the section, "Economic Geology".

GENERAL GEOLOGY

The Grey Owl Lake area consists of an Early Precambrian (Archean) metavolcanic-metasedimentary sequence within the Batchawana Belt of the Superior Province. The metavolcanic-metasedimentary supracrustal sequence has been deformed and metamorphosed. These rocks have also been intruded by a diabase dike swarm that trends at N30°W throughout most of the Batchawana Belt. The area was glaciated during the Pleistocene Epoch which left till, outwash, and boulders over much of the area. Recent accumulations of organic swamp deposits cover the areas of lower relief. Table 1 lists the lithologic units within the map-area.

The age of the supracrustal sequence within the belt is probably at least 2500 million years. This age is inferred from age dates which have been determined from the surrounding granitic terrain (Wanless 1970). The youngest known rocks in the area are the diabase dikes. One of these has been dated at 1035 million years, near the southern boundary of the Batchawana Belt (Wanless 1970). The Batchawana Belt may be a western extension of the Abitibi Belt to the east. These belts were probably separated by the emplacement of the granitic plutons during the Kenoran Orogeny, or the Batchawana Belt may have developed independently of the Abitibi Belt, but approximately at the same time.

The supracrustal rocks are the oldest rocks in the area, and are the metamorphic derivatives of basalt, andesite, dacite, rhyolite, tuff, lapilli-tuff, banded chert and magnetite ironstone, and a variety of metasediments derived from a volcanic source including pelites, wacke, arkose, reworked tuff, conglomerate, and gritty wacke.

In the eastern part of the map-area, the metavolcanic sequence represents one volcanic cycle. The bottom of this cycle is a sequence of mafic to intermediate metavolcanic flows and tuffs 1700 m in thickness intercalated with wackes,

TABLE 1 | TABLE OF LITHOLOGIC UNITS FOR THE GREY OWL LAKE AREA.

PHANEROZOIC

CENOZOIC

QUATERNARY

PLEISTOCENE AND RECENT

Fluvial sand and gravel, silt, clay, and swamp deposits.

Unconformity

PRECAMBRIAN

LATE PRECAMBRIAN

MAFIC INTRUSIVE ROCKS

Porphyritic and non-porphyritic diabase.

Intrusive Contact

EARLY PRECAMBRIAN

FELSIC INTRUSIVE ROCKS

MASIVE FELSIC INTRUSIVE ROCKS

Porphyritic and non-porphyritic quartz monzonite.

Intrusive Contact

FOLIATED FELSIC INTRUSIVE ROCKS

Migmatitic granitic rocks containing assimilated supracrustal rocks, quartz monzonite, granodiorite, trondhjemite, syenodiorite, tonalite, pegmatite, aplite dikes and veins.

Intrusive Contact

METAVOLCANICS AND METASEDIMENTS

METASEDIMENTS

CLASTIC METASEDIMENTS

Quartz-plagioclase, ± biotite ± hornblende ± garnet ± staurolite schist, gneiss and migmatite, arkose, wacke, siltstone; reworked felsic to intermediate metavolcanic tuffs; graphite, slate, conglomerate, paraconglomerate, gritty wacke, pebbly wacke.

CHEMICAL METASEDIMENTS

Banded chert and magnetite ironstone.

METAVOLCANICS

FELSIC TO INTERMEDIATE METAVOLCANICS

Quartz-plagioclase-muscovite ± hornblende ± biotite schist and gneiss, fine-grained banded tuff, ash tuff, crystal tuff, lapilli-tuff.

MAFIC TO INTERMEDIATE METAVOLCANICS

Fine- to medium-grained hornblende-plagioclase schist, medium- to coarse-grained hornblende-plagioclase schists and submassive flows, amphibolites, gneiss, migmatite, tuff,intermediate tuff containing felsic metavolcanic fragments, pillowed flows.

siltstones, banded chert, and magnetite ironstone. The mafic to intermediate metavolcanics are overlain by a sequence of felsic to intermediate metavolcanics up to 6400 m thick composed predominantly of distal tuffaceous deposits with minor amounts of mafic to intermediate metavolcanics and metasedimentary units. The transition zone between the mafic to intermediate metavolcanics and the felsic to intermediate metavolcanics is sharp; dacites lie directly on top of basalts.

The felsic to intermediate metavolcanics are overlain by a sequence of metasediments 1500 to 4800 m thick composed of wacke, reworked tuffs, arkose, conglomerate, and pelites derived from the underlying metavolcanics. The sequence of metasediments has also been interpreted to be a predominantly distal facies environment, or a deep subaqueous environment.

In the map-area, the supracrustal sequence is thickest in the eastern part of the area, and becomes thinner westward. The mafic to intermediate metavolcanics are less than 300 m thick northwest of Mallot Lake. The felsic to intermediate metavolcanics thin out and grade into reworked tuffs interbedded with wackes in the central part of the area. In the western part of the area, reworked tuffs, turbidites, and conglomerates overly the mafic to intermediate metavolcanics, whereas to the east, the felsic metavolcanics are overlain by pelitic type metasediments.

The Alvin Lake area consists of a synform containing mafic to intermediate metavolcanics and coarse-grained clastic metasediments that may be a tectonically dislocated extension of the mafic to intermediate metavolcanics occurring along the southern banks of the Montreal River.

Deformation of the supracrustal rocks was accompanied by the intrusion of large plutons of granodiorite to trondhjemite that envelop the supracrustal sequence. The contact between the supracrustal rocks and the felsic intrusions is in part metasomatic in character and in part sharply discordant. Extensive assimilation and anatexis of the metasediments west of the map-area has occurred where the plutons, probably pre- to syntectonic in origin, intruded from the north and west. These assimilated supracrustal rocks are agmatites, diatexites, and metatexites. The felsic intrusive plutons all display a foliation that generally parallels the margin of the Batchawana Belt.

The belt was later intruded by quartz monzonite stocks and plugs. The largest stock is the Grey Owl Lake Stock which is post tectonic, massive, and undeformed, but is cut by later faults. The contact between the later intrusions and the supracrustal rocks is generally sharp and discordant.

The Montreal River Fault is part of a large fracture-fault system that extends from the southern boundary of the Kapuskasing Structural Zone (Thurston *et al.* 1977), and southwesterly into the Lake Superior Basin (Card *et al.* 1972, p.370). The Montreal River Fault appears to be a large fracture on which only minor displacement has occurred. The fault possibly developed during the uplift of the Kapuskasing Structural Zone and the subsidence of the Lake Superior Basin. The development of this fracture system was accompanied by the emplacement of the Late Precambrian diabase dike swarm that trends at N30°W.

All of the chemical analyses with the exception of one sample have accompanying modal analyses (see Tables 2 to 7). Locations of these samples are plotted on the geological map (Map 2446, back pocket).

Early Precambrian

METAVOLCANICS AND METASEDIMENTS

Mafic to Intermediate Metavolcanics

The mafic to intermediate metavolcanics occur as two distinct sequences within the map-area. The thickest sequence in the map-area occurs in the eastern part of it and thins westward. The thinnest sequence in the area occurs in the Alvin Lake area. The mafic to intermediate metavolcanics in the Alvin Lake Synform are probably a tectonically dislocated extension of the metavolcanics along the Montreal River and were probably deformed during the emplacement of the later granitic rocks.

The mafic to intermediate metavolcanics are predominantly tholeiitic basalt in composition (Figures 2 and 3) according to the classification systems of L.S. Jensen (1976), and T.N. Irvine and W.R.A. Baragar (1971). Chemical and modal analyses of these rocks are shown in Table 2. The metavolcanics have undergone regional metamorphism that ranged from low grade greenshist facies in the southeastern part of the map-area, to middle to upper amphibolite facies (Winkler 1976; Miyashiro 1973) throughout the rest of the area.

The high degree of metamorphism has obliterated almost all the original textures and structures in the supracrustal sequences.

The mafic to intermediate metavolcanics in the Alvin Lake Synform define the outside limbs of the fold. The north limb is approximately 600 m thick and the south limb is approximately 1200 m thick. Both limbs thin eastward where they become interbedded with clastic metasediments derived from metavolcanics. The metavolcanics are predominantly flows that are; medium- to coarse-grained amphibolites, submassive hornblende-plagioclase schists with hornblende porphyroblasts, and fine-grained hornblende-plagioclase units.

The mafic to intermediate metavolcanics that extend from the eastern boundary of the map-area westward along the Montreal River are composed of fine-grained hornblende-plagioclase schist and medium- to coarse-grained, moderately to well foliated, hornblende-plagioclase schist containing poikiloblastic to porphyroblastic hornblende. Westward, where the metamorphic grade is higher, the rocks become increasingly recrystallized to coarser grained amphibolites. This sequence has been interpreted by the author to be a succession of flows and tuffs. The sequence is approximately 1600 m thick at the east boundary of the map-area and thins westward to a thickness of less than 100 m, northwest of Mallot Lake.

Near the top of the sequence, in the eastern part of the map-area, interbeds of wackes, tuffs, and felsic to intermediate metavolcanic tuffs are common. These rocks can be observed along the southern bank of the Montreal River.

Only one outcrop was seen by the field party in the map-area in which flow tops and thicknesses could be measured. The flow thicknesses vary from 1 to 3 m and tops are to the southwest as determined by crystal size gradation from the bottom to the top of the flow. Along the banks of the Montreal River, the

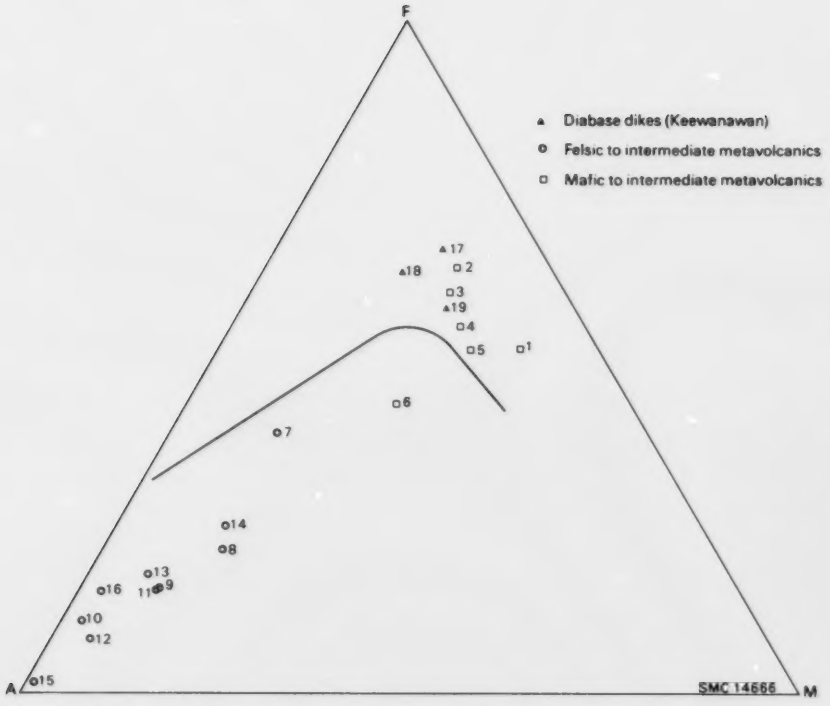


Figure 2–AFM Ternary Diagram of the Grey Owl Lake Metavolcanics and Diabase Dikes.

LEGEND FOR FIGURE 2

Point	Sample Number	Classification (after Irvine and Baragar 1971)
1	M—31—362	High alumina tholeiitic andesite
2	G—34—358	Tholeiitic basalt
3	G—34—363	High alumina cal-alkaline basalt
4	G—18—201	Tholeiitic balsalt
5	G—15—182	High alumina cal-alkaline basalt
6	G—3—31	Calc-alkalic basalt
7	G—25—256	Calc-alkaline dacite
8	G—2—24	Calc-alkaline dacite
9	G—3—40	Calc-alkaline dacite
10	M—19—161	Calc-alkaline rhyolite
11	G—29—285	Calc-alkaline rhyolite
12	G—2—28	Calc-alkaline rhyolite
13	G—28—283	Calc-alkaline dacite
14	M—23—188	Calc-alkaline dacite
15	G—24—245	Calc-alkaline rhyolite
16	G—29—302	Altered calc-alkaline rhyolite
17	M—10—76	Tholeiitic basalt
18	G—3—39	Tholeiitic basalt
19	G—1—16	Tholeiitic basalt

See Tables 2, 3, and 7 for quantitative chemical and modal analyses of these samples and sample locations.
Point numbers are labelled on the geologic map.

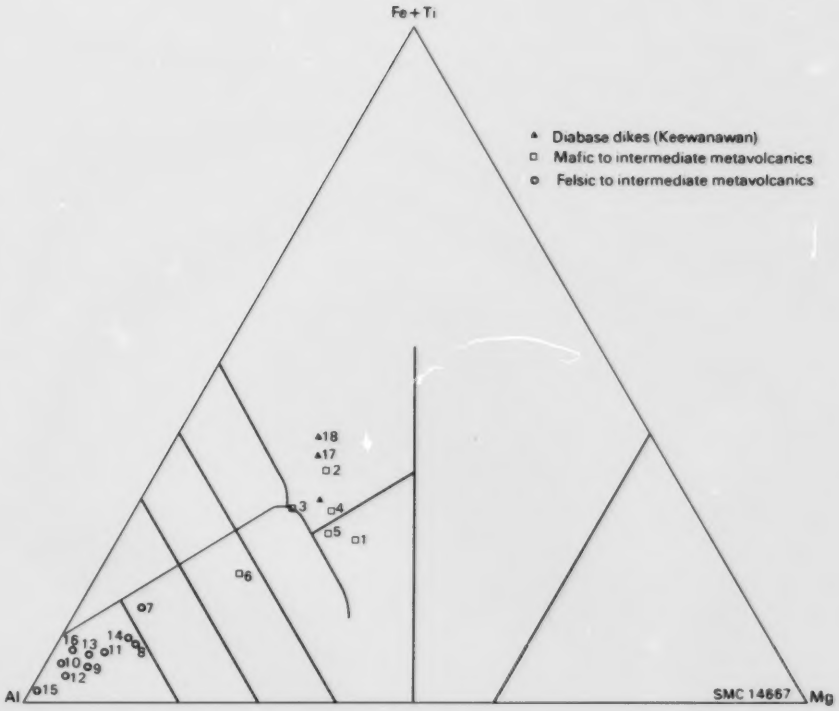


Figure 3 – Jensen Cation Plot of the Grey Owl Lake Metavolcanics and Diabase Dikes.

LEGEND FOR FIGURE 3

Point	Sample Number	Classification (after Irvine and Baragar 1971)
1	M–31–362	High Mg tholeiitic basalt
2	G–34–358	High Fe tholeiitic basalt
3	G–34–363	High Mg tholeiitic andesite
4	G–18–201	High Fe tholeiitic basalt
5	G–15–182	High Mg tholeiitic basalt
6	G–3–31	Calc-alkaline andesite
7	G–25–256	Calc-alkaline dacite
8	G–2–24	Calc-alkaline rhyolite
9	G–3–40	Calc-alkaline rhyolite
10	M–19–161	Calc-alkaline rhyolite
11	G–29–295	Calc-alkaline rhyolite
12	G–2–28	Calc-alkaline rhyolite
13	G–28–283	Calc-alkaline rhyolite
14	M–23–188	Calc-alkaline rhyolite
15	G–24–245	Calc-alkaline rhyolite
16	G–29–302	Calc-alkaline rhyolite
17	M–10–76	High Fe tholeiitic basalt
18	G–3–39	High Fe tholeiitic basalt
19	G–1–16	High Fe tholeiitic basalt

See Tables 2, 3, and 7 for quantitative chemical and modal analyses of these samples and sample locations.
Point numbers are labelled on the geologic map.

bedding of the mafic to intermediate tuffs and intercalated metasediments varies from <1 cm to 30 cm in thickness.

Isolated units of mafic to intermediate metavolcanics occur throughout the metasedimentary and felsic to intermediate metavolcanic sequences. In the felsic to intermediate metavolcanics and metasediments in the east and central parts of the map-area, the mafic units are generally less than 100 m thick. These units are possibly tuffaceous in origin because they occur as fine-grained hornblende-plagioclase schists. There is one exception to this, a medium- to coarse-grained amphibolite occurs in two outcrops about 3.2 km north of Grey Owl Lake. This rock has been interpreted by the author to be a coarse-grained flow, but it may be a small plug of metagabbro. This is the only locality in the map-area where this rock type was observed by the field party. In the western part of the map-area the small mafic units are composed of amphibolite schists. These rocks may be tectonically dislocated from a more extensive unit which formerly joined the Alvin Lake mafic to intermediate metavolcanics and the metavolcanics along the Montreal River.

FINE- TO MEDIUM-GRAINED HORNBLENDE-PLAGIOCLASE SCHIST

Fine-grained hornblende-plagioclase schists predominate in the eastern part of the map-area, and are probably thin flows or tuffaceous units. Where outcrop exposure is poor, the distinction between flows and tuffs is difficult to make. This distinction is further complicated; many of the mafic volcanic-derived wackes near the bottom and upper part of the sequence are mineralogically and texturally similar to these fine-grained schists. The fine-grained schists are light grey-brown to dark grey-brown on the weathered surface and grey-green to dark grey-green on the fresh surface. These schists display a well-developed orientation of hornblende in the place of the foliation. Feldspathic stringers are locally present on the outcrop scale. In thin section, the fine-grained schists are composed of varying amounts of hornblende, plagioclase, epidote, sericite, saussurite, and the opaque minerals, pyrite and magnetite. Minor amounts of quartz, chlorite, and carbonate are also present. This mineralogy is predominant in the mafic to intermediate metavolcanics of the upper greenschist facies and the higher ranking facies. Only one thin section examined displayed a mineralogy and texture representing low grade greenschist facies conditions. The rock from which the thin section was made occurs in a small mafic metavolcanic unit at the eastern boundary of the map-area. Pseudomorphic remnants of pilotaxitic plagioclase microlites in a matrix of saussurite, sericite, actinolite, and magnesium-rich chlorite were observed in thin section.

Thin section examination of the fine-grained recrystallized mafic metavolcanics reveals that they contain subhedral to euhedral hornblende from 0.02 to 0.2 mm across. The hornblende has a pleochroism that is commonly blue-green/green/light yellow. The plagioclase is generally interstitial, anhedral, and equigranular, and varies from 0.08 to 0.2 mm in maximum dimension. The composition of the plagioclase was not optically determined; however, normative plagioclase compositions determined from chemical analyses indicate a compositional range of An_{47} to An_{61}. This is a reasonable indication of the origi-

TABLE 2 | CHEMICAL AND MODAL ANALYSES OF MAFIC TO INTERMEDIATE METAVOLCANICS IN THE GREY OWL LAKE AREA.

MAJOR COMPONENTS IN WEIGHT PERCENT

Sample Number	M-31-362	G-34-358	G-34-363	G-18-201	G-15-182	G-3-31
Point Number	1	2	3	4	5	6
SiO_2	44.7	47.3	47.6	47.8	50.6	51.4
Al_2O_3	16.3	14.7	16.8	15.7	15.8	18.8
Fe_2O_3	12.5	16.1	13.4	13.8	11.8	7.70
MgO	8.55	5.58	5.19	6.70	6.75	4.29
CaO	7.00	9.42	10.4	9.88	9.09	9.98
Na_2O	1.93	2.02	2.31	3.36	3.06	3.74
K_2O	0.25	0.73	0.64	0.25	0.39	1.07
L.O.I.	8.60	1.6	1.1	0.7	1.1	1.6
CO_2	4.40	0.56	0.18	0.21	0.28	0.20
TiO_2	0.94	1.58	1.31	1.10	0.92	1.19
P_2O_5	0.08	0.11	0.09	0.06	0.06	0.08
S	0.01	0.05	0.04	0.01	0.01	0.07
MnO	0.18	0.24	0.21	0.24	0.18	0.21
Total	101.0	99.4	99.1	99.6	99.8	100.1

TRACE ELEMENTS IN PPM						
Ba	60	160	90	70	110	160
Co	50	50	40	50	45	50
Cr	415	55	45	315	280	275
Cu	75	90	40	60	40	80
Li	50	10	10	10	9	10
Ni	125	55	41	130	80	125
Pb	<10	<10	<10	15	35	30
Zn	95	125	110	100	100	240
MODAL ANALYSES (VOLUME PERCENT)						
Quartz		4.0	5.6	0.4		
Plagioclase	8.7	17.2	1.2	20.4	25.6	17.6
Hornblende	1.2	67.8	58.9	75.8	66.4	42.0
Chlorite	41.3	0.8	0.2		5.2	2.6
Muscovite		2.1				
Epidote		0.6	32.3	0.1		
Sericite	0.5					33.3
Saussurite	35.0	3.9				
Minerals Opaque	3.5	3.0	2.0	3.3	2.8	1.0
Carbonate	7.7	0.1				3.0
Actinolite	2.1					

FOOTNOTES

[1] Muscovite

[2] Plagioclase and sericite

[3] Sericite and Saussurite

NOTES FOR TABLE 2

M-31-362 Fine-grained mafic metavolcanic rock, 3 km east of Doyle Lake on map-area boundary. Longitude 84.04581, Latitude 47.28040.

G-34-358 Fine-grained hornblende-plagioclase schist, 1900 m east of south bay of the Montreal River east part of map-area, Longitude 84.10982, Latitude 47.31719.

G-34-363 Medium-grained hornblende-plagioclase flow, submassive with hornblende-plagioclase flow, submassive with hornblende porphyroblasts, 2450 m southeast of south bay on Montreal River, east part of map-area, Longitude 84.10414, Latitude 47.31009.

G-18-201 Fine-grained hornblende plagioclase schist, 3050 m southeast of south bay on the Montreal River, east part of map-area, Longitude 84.09492, Latitude 47.31207.

G-15-182 Medium-grained hornblende-chlorite-plagioclase flow, submassive with porphyroblasts and poikiloblasts of hornblende, 2500 m east of Alvin Lake, Longitude 84.25203, Latitude 47.26165.

G-3-31 Medium-grained hornblende-plagioclase-sericite flow, submassive, Montreal River Narrows, central part of map-area, Longitude 84.22123, Latitude 47.32230.

PLEASE NOTE: CO_2 is included in L.O.I.
S is not included in total.

Chemical Analyses by Geoscience Laboratories,
Ontario Geological Survey.

nal plagioclase composition; but the An component of the mafic metavolcanics is probably significantly lower because part of the calcium has been utilized by epidote and hornblende.

Saussurite and sericite were noted in some thin sections. The presence of these minerals represents either; 1) a residual low grade metamorphic phase that was not subsequently recrystallized, or 2) a retrograde metamorphic effect. Chlorite mantles hornblende to a small extent, and is possibly a retrograde metamorphic effect.

MEDIUM- TO COARSE-GRAINED HORNBLENDE-PLAGIOCLASE FLOWS AND SCHIST

The medium- to coarse-grained hornblende-plagioclase submassive to schistose rocks have been interpreted by the author to be thick coarse-grained flows. These rocks display gradations in grain size in the field which enabled the author to locally determine stratigraphic tops. The lowest part of the flows consist of medium- to coarse-grained hornblende up to 2.0 mm across. Hornblende toward the top of the flow becomes progressively finer grained than the lowest part of the flow. These rocks are grey-brown to dark grey-brown on the weathered surface and are dark grey-green on the fresh surface. The matrix is composed of fine-grained hornblende and plagioclase; abundant hornblende porphyroblasts and poikiloblasts up to 2.0 mm across commonly give the rock a submassive appearance. The matrix is composed of hornblende, epidote, plagioclase, sericite, opaque minerals, and chlorite. Alteration of the plagioclase to sericite and the mantling of hornblende by minor amounts of chlorite is probably a retrograde metamorphic effect. Hornblende occurs as subhedral to euhedral crystals as much as 0.5 mm long in the matrix, and also occurs as anhedral porphyroblasts as much as 2.0 mm across. The poikiloblasts are composed of anhedral to euhedral hornblende crystal aggregates. Plagioclase is generally interstitial and anhedral in form, and epidote occurs as stubby crystals generally less than 0.1 mm across. The opaque minerals are small, less than 0.05 mm across, and are dispersed throughout the matrix.

AMPHIBOLITES (GNEISSIC AND MIGMATITIC)

Gneissic and migmatitic amphibolites are recrystallized flows which have been metamorphosed under at least middle amphibolite facies conditions, and are most common along the south bank and the north bank of the Montreal River. These rocks are characterized by a medium- to coarse-grained hornblende plagioclase assemblage that is light grey-brown to grey-brown on the weathered surface, and dark grey-green on the fresh surface. The foliation is defined by the hornblende orientation and hornblende-, epidote-, and plagioclase-rich bands. The texture on the weathered surface resembles a foliated diabasic texture. In the migmatitic types, the plagioclase bands have become partly remobilized and are generally coarser grained with the introduction of quartz parallel to the banding. The mineralogy consists primarily of hornblende, plagioclase, epidote, sericite, chlorite, opaque minerals, and quartz.

Along the bank of the Montreal River, examination of the amphibolites reveals alteration of plagioclase to sericite, and chlorite mantling hornblende which is a retrograde metamorphic effect. Garnet was noted in a few outcrops and may indicate metamorphism under conditions of relatively high pressure amphibolite metamorphic facies occurred (Winkler 1976).

Thin section examination reveals that hornblende occurs as subhedral to euhedral poikiloblastic aggregates, and plagioclase occurs as anhedral interstitial aggregates. The amphibolites grade into the fine-grained hornblende-plagioclase schist and the coarse-grained porphyroblastic submassive hornblende-plagioclase schist. This gradation indicates that these rock types are, in some places, metamorphic equivalents of each other. Metasomatic assimilation of the mafic to intermediate metavolcanics into tonalite and hornblende-bearing gneiss occurs in the Alvin Lake area and along the contact zone on the north bank of the Montreal River.

TUFF

Mafic to intermediate metavolcanic tuff was observed in the eastern part of the map-area near the upper part of the metavolcanic sequence. Good exposures are required to identify these rocks as tuffs. The tuffs were most easily recognized along the banks of the Montreal River and are interbedded with metasediments and felsic to intermediate metavolcanic-tuffs. The tuff also occurs as intermittent beds within the felsic to intermediate metavolcanic sequence. The tuffs are characterized by thin bedding (3 to 10 cm), grey-brown weathering, dark grey-green fresh surfaces, and a fine-grained hornblende-plagioclase mineral assemblage with a well-developed hornblende schistosity. In areas of poor exposure, the bedding is not easily recognized. The tuffs are easily confused with the fine-grained hornblende plagioclase schists that are possibly flows. The tuffs may also be confused with the mafic to intermediate metavolcanic wackes that commonly occur as interbeds associated with the upper part of the mafic to intermediate sequence. These wackes occur also as interbeds associated with the banded chert and magnetite ironstone in the lower part of the sequence. The tuffs have a mineralogy and texture identical to that of the fine-grained hornblende-plagioclase schists described previously.

INTERMEDIATE METAVOLCANIC TUFF

Intermediate metavolcanic tuff containing felsic metavolcanic fragments occurs within the felsic to intermediate sequence that can be traced intermittently from southeast of Doyle Lake northwestward to a small lake about 900 m north of Doyle Lake. These tuffs consist of a sequence of interbedded mafic to intermediate metavolcanic fine-grained tuff and tuff with lapilli-sized felsic to intermediate pyroclastic fragments (Photo 1). The matrix is generally a fine-grained hornblende-chlorite schist which commonly shows the development of almandine garnet up to 2.0 mm across. The felsic to intermediate pyroclastic

OGS 10 239

Photo 1–Mafic to intermediate tuff with felsic to intermediate lapilli fragments. 1400 m east of Doyle Lake.

fragments constitute 30 to 80 percent of the rock, and are light grey to cream weathered, stretched, and angular in form. The fragments are composed of quartz-plagioclase-muscovite schist, and are about 4 to 6 cm long and 1 to 3 cm wide. The tuffaceous sequence is less than 75 m thick. The sequence is underlain by felsic to intermediate metavolcanic tuff and lapilli-tuff, and is overlain by fine-grained felsic to intermediate tuff.

PILLOWED FLOWS

Only two outcrops suggest pillowed flows in the map-area. One outcrop is located north of Mallot Lake at the contact of the metavolcanics and metasediments. The other outcrop is located in the eastern part of the map-area, on the

southeast edge of the bay that is on the southern bank of the Montreal River. Both outcrops display long stringers that are hornblende and epidote rich and might be reminiscent of selvages (Holland and Norris 1979), but the stringers do not appear to terminate, and form closed structures. Recognition of pillowed flows in the map-area is made difficult by the high metamorphic grade, strong deformation, and poor exposure of the metavolcanics.

Felsic to Intermediate Metavolcanics

The felsic to intermediate metavolcanics occur as a thick sequence of ash tuff, crystal tuff, and lapilli-tuff. This sequence is approximately 6400 m thick in the southeast corner of the map-area and extends northwest. There, it thins and grades into reworked metasedimentary tuff along the southern bank of the Montreal River.

The sequence may be part of a major syncline that extends eastward from the southeastern corner of the map-area boundary. A synclinal axis, however, is not indicated on Map 2446, back pocket. The author believes additional lithologic and structural evidence is needed from the area to the east for a synclinal axis to be placed on the map. If the sequence is part of a syncline, the sequence it is probably less than 3000 m thick. The tuffs consist of at least 80 percent fine-grained ash tuff. The author has interpreted the tuff to be a distal facies of metavolcanics that may be time related to the tuffs and pyroclastic breccias which occur above the lowest mafic to intermediate metavolcanics in the Cowie Lake area (Grunsky 1980).

Compositionally, the felsic to intermediate metavolcanics are dacites and rhyolites as shown in Figures 2 and 3. Chemical and modal analyses are shown in Table 3. The felsic to intermediate metavolcanics have undergone regional and contact metamorphism.

Textural changes appear to be the most reliable indication of metamorphic grade. The tuffs are invariably composed of a quartz-plagioclase-muscovite ± chlorite ± biotite ± hornblende ± epidote ± garnet schist. Where lower metamorphic grades (middle to upper greenschist facies) are exposed, these schists are fine grained with chlorite as the principal ferromagnesian component. As the schists approach conditions pertaining to amphibolite facies metamorphism, biotite, hornblende, and epidote develop as poikiloblasts and porphyroblasts (Photo 2). Garnet is present in rocks that might be interpreted to have formed under conditions of higher pressure amphibolite facies.

The contacts between the felsic to intermediate metavolcanics and the underlying mafic to intermediate metavolcanics are characterized by a sequence of intercalated mafic to intermediate tuffs, metasedimentary wacke, and felsic to intermediate tuffs. The transition zone is relatively narrow, and is less than 50 m thick. This can be observed along the southern bank of the Montreal River on the peninsula in the east-central part of the map-area. The upper contact of the felsic to intermediate metavolcanics is sharp in the Doyle Lake area where the underlying felsic rocks are overlain by metasediments with almost no transition zone or interbedding present. Towards the northwest of the map-area, a transition zone develops where wackes and felsic tuffs are interbedded, and in

this area, the tuffs are grouped with the metasediments as waterlain, possibly reworked deposits.

In most outcrops, bedding thicknesses and other primary features are not visible due to poor exposure and/or the recrystallization that has obliterated the primary features.

QUARTZ-PLAGIOCLASE-MUSCOVITE SCHIST AND GNEISS

The most common type of felsic to intermediate metavolcanic in the map-area is a fine-grained quartz-plagioclase-muscovite schist. Gneissic textures composed of medium-grained granoblastic and porphyroblastic biotite, plagioclase, and hornblende are locally developed near the Montreal River. This rock type, lacking any recognizable primary features that might indicate its origin, is most probably tuffaceous. The rock is commonly buff to buff-grey on the weathered surface and cream to buff on the fresh surface. The more intermediate schists usually are slightly darker on the fresh surface than the weathered surface. In the low grade metamorphic areas, the rocks can be scratched with a knife. Under higher grade metamorphism, the rocks become quite hard due to increased grain size from the recrystallization of quartz and feldspar.

These schists are composed of quartz, plagioclase, chlorite, muscovite, biotite, epidote, sericite, saussurite, hornblende, and opaque minerals. Epidote and hornblende are more common in the intermediate dacites that have been subjected to amphibolite facies metamorphism than in dacites which have been subjected to lower grade metamorphism. In the lower grade (greenschist facies) metamorphic schist, quartz and plagioclase occur as subrounded angular grains 0.04 to 0.1 mm across. The higher grade metamorphic schists display granoblastic quartz and plagioclase, ragged flakes of biotite, and porphyroblasts of hornblende. Muscovite, sericite, and saussurite are commonly part of the interstitial groundmass, and chlorite and biotite are commonly subhedral crystals defining the schistosity. Garnets up to 2.0 mm in size across occur in schists that are partly enclosed by the Grey Owl Lake Stock, and these garnets occur eastward where the schists may have been subjected to higher pressure by the intrusions southwest of Doyle Lake.

TUFF

The tuffaceous felsic to intermediate metavolcanics were recognized by their banded appearance in outcrop and form about 95 percent of the felsic to intermediate metavolcanic sequence. These rocks are buff, buff-grey, or cream coloured on the fresh and weathered surfaces, and are composed of the fine-grained quartz-plagioclase-muscovite schists already described. Texturally and mineralogically these rocks are identical to the previously discussed fine-grained schists. The tuffaceous rocks are characteristically banded ash tuff with minor amounts of interbedded crystal tuff. The fine-grained nature of these rocks persists throughout the entire sequence. This suggests that the rocks were deposited in a distal facies environment. Dacite tuffs with quartz

TABLE 3 | CHEMICAL AND MODAL ANALYSES OF FELSIC TO INTERMEDIATE METAVOLCANICS IN THE GREY OWL LAKE AREA.

MAJOR COMPONENTS IN WEIGHT PERCENT

Sample Number	G-25-256	G-2-24	G-3-40	M-19-161	G-29-295	G-2-28	G-28-283	M-23-188	G-24-245	G-29-302
Point Number	7	8	9	10	11	12	13	14	15	16
SiO_2	61.40	62.90	69.60	67.60	68.20	68.40	69.30	70.50	71.10	59.50
Al_2O_3	19.50	18.60	16.60	18.70	17.40	17.20	16.30	15.50	17.10	21.50
Fe_2O_3	4.87	2.77	1.30	1.23	1.79	0.86	1.78	2.53	0.16	2.27
MgO	1.57	1.78	0.78	0.27	1.03	0.48	0.71	1.27	0.08	0.41
CaO	3.01	2.54	2.96	1.41	1.07	1.30	1.35	2.48	1.80	1.83
Na_2O	3.37	3.93	4.10	6.83	6.82	5.39	1.14	4.44	5.25	8.04
K_2O	2.02	3.36	1.41	1.89	0.93	2.80	5.65	1.11	1.79	2.82
L.O.I.	1.70	2.30	1.60	1.20	1.30	0.90	1.50	1.10	0.80	1.20
CO_2	0.44	0.47	0.45	0.23	ND	0.24	0.18	0.38	0.27	0.08
TiO_2	0.67	0.32	0.29	0.57	0.57	0.27	0.26	0.31	0.33	0.70
P_2O_5	0.17	0.07	0.05	0.15	0.17	0.05	0.06	0.06	0.07	0.15
S	<0.01	<0.01	<0.01	<0.01	<0.01	0.01	<0.01	0.02	<0.01	<0.01
MnO	0.08	0.04	0.03	0.07	0.03	0.03	0.04	0.04	0.03	0.08
Total	98.36	98.61	98.72	99.92	99.31	97.68	98.09	99.34	98.51	98.50

TRACE ELEMENTS IN PPM

Ba	380	880	430	360	120	1000	810	400	360	440
Co	20	10	6	<5	<5	6	6	6	8	7
Cr	40	25	15	30	40	15	7	14	10	72
Cu	30	20	5	10	<5	<5	<5	9	<5	7
Li	20	15	10	10	10	6	20	55	4	22
Ni	25	15	6	5	7	9	6	9	10	12
Pb	15	55	15	<10	<10	45	10	25	15	14
Zn	55	85	45	40	30	30	25	50	20	28

MODAL ANALYSES (VOLUME PERCENT)

Quartz	23.40	23.70	42.60	27.10	34.10	1.30	29.50	41.50	15.50
Plagioclase	34.20	8.90	38.60[2]	64.30	49.60	52.10	63.00	43.30	69.70[3]
Potassium Feldspar		2.50						2.80	
Biotite	20.30					4.20	2.20[5]	0.10	
Chlorite	0.40[4]	13.10	9.20	4.90[6]	5.40	3.80			6.40
Muscovite	16.70	1.80	4.90		9.40	38.50		8.50[7]	7.00
Epidote	2.80								
Sericite		42.60							
Saussurite		6.50[1]	3.50						0.40
Opaque Minerals	2.20		1.20	3.70	1.50	0.10	5.30	3.80	1.00
Carbonate		0.90							

NOTES FOR TABLE 3

G-25-256 Fine-grained tuff, 2.6 km southeast of Doyle Lake, Longitude 84.10351, Latitude 47.25476.
G-2-24 Recrystallized tuff, 2.300 m east of Narrows or Montreal River on south shore, Longitude 84.18886, Latitude 47.31143.

G-3-40 Fine-grained tuff, 2 100 m east of Narrows or Montreal River on south shore, Longitude 84.18949, Latitude 47.31832.

M-19-161 Fine-grained banded tuff, 2 000 m southwest of Doyle Lake, Longitude 84.15502, Latitude 47.25994.

G-29-295 Fine-grained banded tuff, Doyle Lake, north shore, Longitude 48.12958, Latitude 47.28480.

G-2-28 Fine-grained tuff, 2 750 m north of Grey Owl Lake, Longitude 84.18571, Latitude 47.29801.

G-28-283 Fine-grained tuff, 1,850 m east northeast of Doyle Lake, Longitude 84.09700, Latitude 47.30994.

M-23-188 Fine-grained banded tuff, 900 m southeast of south bay on Montreal River in east part of map-area, Longitude 84.12853, Latitude 47.31023.

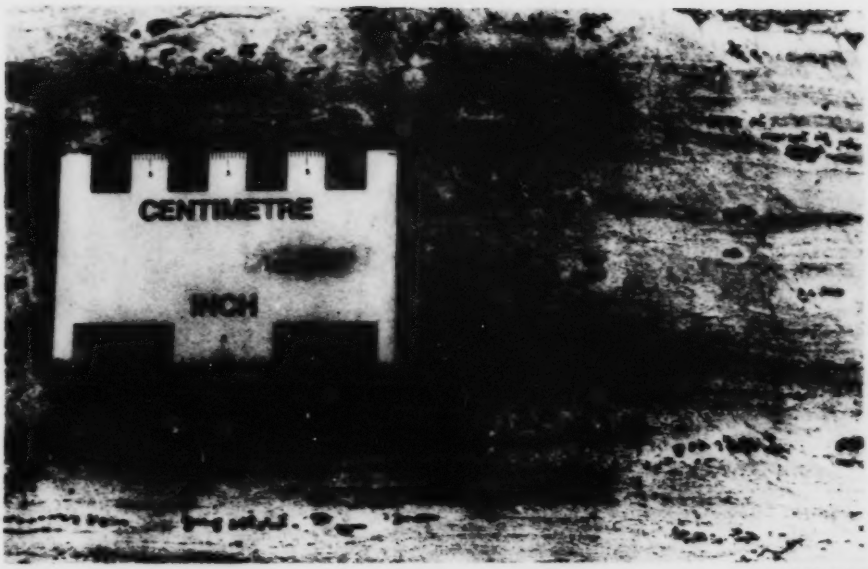
G-24-245 Crystal tuff, 1 200 m northwest of Doyle Lake, at east end of small lake, Longitude 84.15281, Latitude 47.29212.

G-29-302 Recrystallized tuff, Narrows, east part of Doyle Lake, see Photos 2 and 3, Longitude 84.13273, Latitude 47.28239.

PLEASE NOTE:
CO_2 is included in L.O.I.
S is not included in total
ND - Not determined

FOOTNOTES
[1] Saussurite and opaque minerals.
[2] Plagioclase and sericite.
[3] Plagioclase and potassium feldspar and sericite.
[4] Chlorite and epidote/clinozoisite.
[5] Biotite and sericite and saussurite and muscovite and chlorite.
[6] Chlorite and unidentifiable groundmass.
[7] Muscovite and sericite.

Chemical analyses by Geoscience Laboratories, Ontario Geological Survey



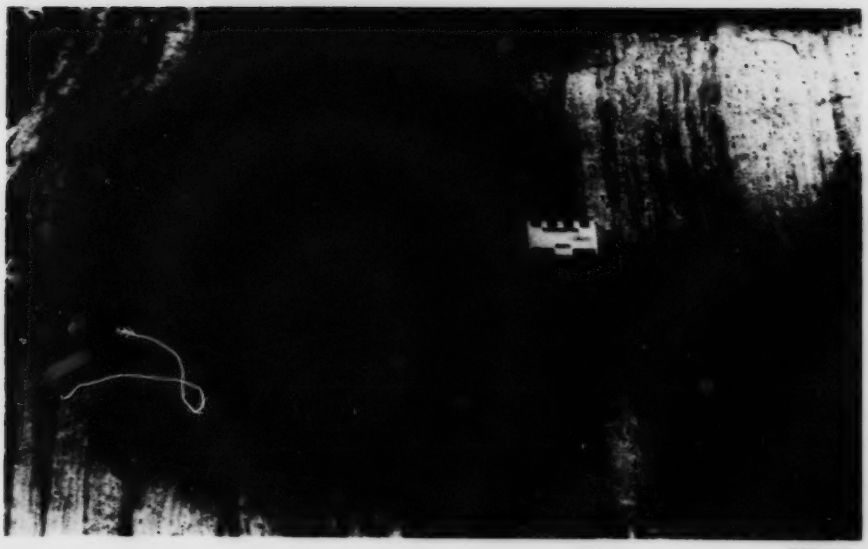
OGS 10 240

Photo 2–Porphyroblasts of hornblende in felsic to intermediate banded tuff. Note the stictolithic hornblende. Doyle Lake.

crystals up to 2.0 mm across are more common in the lower part of the sequence east of Doyle Lake; whereas the tuffs at the top of the sequence in the Doyle Lake area tend to be rhyolitic in composition.

The banded fine-grained ash tuffs are characterized by regular to irregular bedding, and in places, by vaguely banded quartz-plagioclase-muscovite schists containing accessory biotite, hornblende, chlorite, and garnet. Bedding thickness varies from very thinly bedded to medium bedded (1 cm to 30 cm), and usually reflects compositional variations. Vaguely banded tuffs reflect less compositional variation than tuffs having regular beds. Good exposures of banded tuffs can be observed along the southern banks of the Montreal River and along the shoreline of Doyle Lake (Photos 2 and 3). Graded bedding was observed in several beds within the banded tuffs north of Doyle Lake that consist of fine-grained ash tuffs with feldspar crystals slightly larger than those in the rest of the rock near the bottom of the bed.

Crystal tuff occurs sporadically throughout the felsic to intermediate metavolcanic sequence. In the lower part of the sequence, the dacitic tuffs commonly contain rounded quartz crystals up to 2.0 mm across. In the middle and upper parts of the sequence, rhyolitic tuffs contain abundant plagioclase crystals (Photo 4). The plagioclase crystals are angular to subangular and vary from 0.5 to 3.0 mm across, and form from 10 to 40 percent of the rock.



OGS 10 241

Photo 3–Banded felsic to intermediate tuff on Doyle Lake. Note the stictolithic texture of the honblende. The dark unit is a mafic to intermediate tuff.

OGS 10 242

Photo 4–Crystal tuff with plagioclase fragments, 1.2 km northwest of Doyle Lake.

OGS 10 243

Photo 5–Garnetiferous lapilli-tuff, 900 m north of Doyle Lake.

LAPILLI-TUFF

Rock identified as lapilli-tuff using the classification made by R.V. Fisher (1966), occurs in minor quantities throughout the felsic to intermediate metavolcanic sequence at the following places: east of Doyle Lake, near and within the intermediate tuff containing felsic metavolcanic fragments, and in the upper part of the sequence northwest of Doyle Lake associated with crystal tuff. The lapilli fragments are subangular to subrounded in shape, stretched, rhyolitic to dacitic in composition, and weather white to buff. Fragment size varies from 2.0 to 6.0 cm, but a few fragments up to 10 cm were noted northeast of Doyle Lake. The fragments constitute 40 to 80 percent of the rock and the matrix is composed of fine-grained quartz-plagioclase-muscovite ± hornblende ± garnet schist (Photo 5).

Chemical Metasediments

BANDED CHERT AND MAGNETITE IRONSTONE

Banded chert and magnetite ironstone of oxide-facies type (Gross 1965) were observed in the eastern part of the map-area near the lowest part of the

mafic to intermediate metavolcanic sequence. Interlayered chert and ironstone form units 10 cm to 1 m thick, and are interbedded with wacke and metavolcanic hornblende schist.

The ironstone is composed of magnetite, chert, and amphibole (probably grunerite) bands varying from less than 1 mm to 1 cm in thickness and is interbedded with magnetitic chert bands 1 mm to 3 cm in thickness. Outcrop exposure in the eastern part of the map-area is poor and only two outcrops were located by the field party.

The ironstone is black to dark grey on the fresh and weathered surfaces and is fine grained. Examination of the two outcrops revealed that iron composes 25 percent of the chert and ironstone. The deposition of the chert and ironstone and associated wackes represents a break in volcanic activity, but apparently the accumulation of the chemical metasediments is minor in quantity. The aeromagnetic expression of the ironstone is irregular, but distinct, and can be traced from the southern bank of the Montreal River eastward past the map-area boundary. The irregular expression of the ironstone may be due to local deposition in small basins, or from tectonic dislocation during deformation at the edge of the belt.

Banded chert and magnetite ironstone east of Mallot Lake have been reported in the Assessment Files Reseach Office, Toronto. However, the author was unable to locate any outcrops of this unit during field mapping. The aeromagnetic expression is pronounced and has been interpreted by the author as chert/ironstone on the geological map (Map 2446, back pocket).

CLASTIC METASEDIMENTS

The metasediments compose about 60 percent of the supracrustal rocks in the map-area. The metasediments are predominantly wacke, arkose, conglomerate, and pelite. These rocks display a wide variety of compositions, textures, and the mineralogy of various metamorphic grades. These rocks overlie the felsic to intermediate metavolcanics in the east-central part of the area, and are interlayered with the mafic to intermediate metavolcanics in the western part of the map-area. Stratigraphic relationships between the metavolcanics and metasediments have been obscured by remobilization of granitic rocks and tectonic dislocation in the western part of the map-area.

The metasediments are divided into an upper unit and a lower unit. The lower unit, about 700 m thick, outcrops in the eastern part of the map-area. It is composed of wackes and deep waterlain felsic to intermediate metavolcanic tuffs that are sedimentary in origin, and is overlain by a wacke assemblage that becomes increasingly conglomeratic upward in the sequence. An upper unit consists of schists that are pelitic wackes in origin. This unit occurs north of the Grey Owl Pluton and overlies the felsic metavolcanics in the southeastern part of the map-area. The eastern sequence represents a facies change from a felsic metavolcanic environment to an increasingly clastic environment. West of the Grey Owl Lake Fault, the metasediments are gneissic to migmatitic and cannot be correlated with rocks east of the fault. Conglomerates and turbidites north of Union Lake are highly metamorphosed.

Grey Owl Lake Area

The metasediments in the Alvin Lake Synform are predominantly interbedded wackes and conglomerates similar in composition and type of clast to the conglomerates and wackes north of Union Lake and southeast of Mallot Lake. It may be possible that those units were once joined together.

These rocks have probably been derived from the mafic to felsic metavolcanics. The wackes have been generally derived from the mafic to intermediate metavolcanics and the arkosic rocks have been derived from the felsic to intermediate metavolcanics. The gritty wackes and conglomerates generally contain a wacke matrix derived from mafic metavolcanics and also contain felsic fragments derived from the felsic metavolcanics. Chemical and modal analyses of these rocks are given in Table 4.

Metamorphic grade varies from upper greenschist facies to upper amphibolite facies and includes metasomatic anatexis from the surrounding granitic intrusives at the belt boundary. Primary features are rarely preserved because much of the metasedimentary sequence has either been contact metamorphosed by the Grey Owl Lake Stock, or has undergone regional metamorphism near the north edge of the belt. The lowest grade of metamorphism in the map-area is located in the centre of the Alvin Lake Synform and is upper greenschist to lower amphibolite facies metamorphism. Graded beds in interbedded wackes and arkose were observed west of Mallot Lake, and indicate tops occur to the south. Generally, the only primary features that are preserved are the highly stretched pebble- and cobble-sized clasts in the gritty wackes and conglomerates, and the compositional banding in the turbidites west of Mallot Lake.

QUARTZ-PLAGIOCLASE-BIOTITE ± HORNBLENDE SCHIST, AND MIGMATITE GNEISS

The most common type of metasediment in the map-area is a fine- to medium-grained quartz-plagioclase-biotite ± hornblende ± garnet schist and gneiss and the anatectic equivalents of these rocks, metatexite and diatexite. These rocks are generally metamorphosed to the middle amphibolite facies.

The rock names used in this section of the report are applied to outcrops in which no diagnostic feature is observable. A genetic classification of the rocks is difficult and is aided by extrapolation of units from the east end of the map-area, to the west end. On this basis most of the quartz-plagioclase biotite schists are undoubtedly wackes in origin. Outcrop exposure also presents a problem because only coarse primary features are preserved (coarse clasts). The criteria used in a genetic classification may not be observed in areas of poor outcrop. The biotite-rich schists containing nodules of staurolite have been interpreted to be pelitic rocks.

The schistose rocks vary from grey-brown to dark grey on the weathered surface and vary from dark grey to black on the fresh surface, and are fine to medium grained. Biotite and hornblende define the schistosity, and commonly occur as poikiloblasts and porphyroblasts. The higher grade metamorphic schists often contain medium-grained quartzofeldspathic stringers parallel to the schistosity.

The schists are composed of recrystallized quartz, plagioclase, biotite, hornblende, muscovite, chlorite and accessory sericite, garnet, and opaque miner

als. The texture is equigranular with porphyroblastic and poikiloblastic biotite and hornblende. Retrograde staurolite occurs in pelitic schists north of the Grey Owl Lake Stock. Garnet commonly occurs in the form of poikiloblastic aggregates containing inclusions of quartz, chlorite, and plagioclase, this is probably a retrograde metamorphic effect. Quartz and plagioclase are usually recrystallized to subhedral and euhedral equigranular crystals with accompanying bands of subhedral to euhedral ferromagnesian minerals. Hornblende-rich schists are more commonly associated with wackes probably derived from mafic to intermediate metavolcanics.

The gneissic to migmatitic metasediments are characterized by extensive recrystallization and the formation of a quartz-plagioclase mobilizate. This has changed the rocks into metatexitic migmatites (Mehnert 1968). The gneissic metasediments are compositionally banded medium-grained rocks associated with the migmatitic metasediments. These rocks, restricted to the western part of the map-area, represent metasomatic assimilation of the supracrustal rocks by the felsic intrusive plutons from the west and north. These rocks also extend north of the Montreal River into the migmatitic granitic complex. In this area, assimilation has been more extensive; therefore the rocks are grouped within the felsic intrusive complex. In the area north and northwest of Union Lake, the metasediments display gross primary features such as bedding, and conglomeratic clasts. However, the rocks contain numerous injections of pegmatite and have *in situ* development of quartz-feldspar leucosome mobilizate. Photo 6 shows a boudinaged pegmatitic neosome within a turbidite sequence. A leucosome mobilizate is generally associated with the development of a melanosome. The melanosome comprises a medium- to coarse-grained mafic-rich phase of biotite, hornblende, and occasionally garnet which has segregated out of the leucosome. This is common in many of the metatexites northwest of Union Lake. The metasediments are recrystallized into medium-grained, granoblastic to subgranoblastic schists. These rocks have an extensive network of mobilizate which indicates that these rocks have been partly melted. The neosome varies from 10 to 30 percent of the rock south of the Montreal River; however, locally, it is as high as 60 percent. In outcrops where the leucosome mobilizate is more extensive, the paleosome is coarser grained than the leucosome mobilizate. The rock is almost like a granite gneiss in texture, and is a granodiorite to trondhjemite in composition. The progressive development of metatexite to diatexite can be observed in traversing towards the granodiorite to trondhjemite plutons in the southwestern and northern parts of the map-area, but locally the metasediments can be remarkably well preserved.

WACKE AND ARKOSE

Wackes and arkoses are the most common rocks in the lower metamorphic grade metasediments. These rocks occur within the Alvin Lake Synform and eastward from Mallot Lake along the banks of the Montreal River and southeasterly to Doyle Lake. The wackes are more abundant and characteristically biotite or hornblende rich as compared to the arkoses which usually contain

TABLE 4 | CHEMICAL AND MODAL ANALYSES OF METASEDIMENTS IN THE GREY OWL LAKE AREA.

COMPONENTS IN WEIGHT PERCENT

Sample Number	G-12-146	M-21-168	G-12-145	G-3-35	G-10-125	G-36-389	M-2-14	S-2-21
Point Number	20	21	22	23	24	25	26	27
SiO_2	57.50	59.40	59.70	62.20	62.20	63.20	65.10	58.00
Al_2O_3	19.10	15.70	17.80	16.80	17.60	17.20	17.30	19.10
Fe_2O_3	7.60	9.55	6.82	7.03	6.11	4.01	3.17	6.02
MgO	2.68	2.74	3.10	3.21	3.01	2.71	1.63	4.25
CaO	2.53	2.92	4.00	2.41	2.42	3.04	2.77	3.92
Na_2O	2.65	4.08	2.06	3.45	4.75	5.53	4.34	0.90
K_2O	3.20	1.36	2.63	1.66	1.74	2.06	2.07	4.25
L.O.I.	2.90	1.30	1.90	2.30	1.90	0.90	1.60	2.20
CO_2	1.61	0.08	0.46	0.26	0.19	0.10	0.44	ND
TiO_2	0.72	0.98	0.64	0.63	0.65	0.42	0.42	0.67
P_2O_5	0.13	0.08	0.16	0.15	0.15	0.14	0.05	0.18
S	0.06	0.01	0.05	0.14	0.05	<0.01	0.01	0.59
MnO	0.08	0.09	0.10	0.11	0.09	0.06	0.16	0.07
Total	99.09	98.20	98.91	99.95	100.62	99.27	98.61	99.56
TRACE ELEMENTS IN PPM								
Ba	870	470	540	350	390	470	500	500
Co	20	25	20	20	15	15	15	35
Cr	220	<5	210	220	230	80	45	230
Cu	60	<5	50	55	20	<5	8	215
Li	40	20	45	30	25	70	15	40
Ni	65	<5	75	65	55	35	35	115
Pb	15	<10	25	15	15	15	10	15
Zn	65	85	90	85	65	70	75	65

MODAL ANALYSES (VOLUME PERCENT)

Quartz	26.50	29.80	23.10	28.00	26.40	24.40	25.90	32.70
Plagioclase	32.00	29.40[1]	39.70	14.70	40.20	44.90	43.10	23.90
Potassic Feldspar						2.60	1.00	
Hornblende		3.80				5.70		
Biotite	21.90	27.30[2]	37.10[2]		24.30	21.90	5.40	28.70
Chlorite	7.20			35.70	3.30		8.50	
Muscovite	6.30						4.20	
Epidote		2.80					1.40	1.10
Sericite				18.20	3.90		10.40	10.80
Opaque	5.10	6.90	0.10	1.90	1.00	0.50	0.10	2.50
Minerals								
Garnet				1.50	0.90			
Apatite	1.00							0.30

NOTES FOR TABLE 4

G-12-146 Garnetiferous biotite schist, pelitic, 2 400 m north northwest of Doyle Lake, Longitude 84.14955, Latitude 47.30369.

M-21-168 Hornblende-biotite schist with minor magnetite 1 500 m north of Grey Owl Lake, Longitude 84.20736, Latitude 47.28821.

G-12-145 Biotite schist-wacke, 2 400 m north northwest of Doyle Lake, Longitude 84.14955, Latitude 47.30369

G-3-35 Wacke, fine to medium grained, south shore along Montreal River, at narrows, Longitude 84.21619, Latitude 47.32003.

G-10-125 Garnetiferous biotite schist, 600 m west of Union Lake, Longitude 84.28051, Latitude 47.28842.

G-36-389 Gritty wacke, 1 400 m northwest of Union Lake, see Photo 6, Longitude 84.27977, Latitude 47.30135.

M-2-14 Arkose, 1 700 m southeast of narrows of Montreal River, Longitude 84.20620, Latitude 47.30781.

S-2-21 Biotite gneiss, see Photo 8, 2 500 m east of west boundary of map-area on north shore of Montreal River, Longitude 84.28471, Latitude 47.32202.

FOOTNOTE:

[1]Plagioclase and Sericite.
[2]Biotite and chlorite.
ND Not determined.

PLEASE NOTE:

CO_2 is included in L.O.I.
S is not included in total

Chemical analyses by Geoscience Laboratories, Ontario Geological Survey

OGS 10 244

Photo 6–Banded wackes in turbidites, 2.6 km west of Mallot Lake. Note the leucosome developed due to anatectic metamorphism in the upper right corner of the photo.

less than 10 percent mafic minerals. Both rock types have probably been derived from metavolcanic sources. The wackes are commonly interbedded with the conglomeratic units, the mafic to intermediate metavolcanics, and the waterlain tuffs south of the Montreal River. Wackes are light grey to dark grey on the fresh surface, light grey-brown to grey-brown on the weathered surface. Wackes have a characteristic granular texture in the lower metamorphic grade parts of the map-area. Arkose is generally light to buff-grey on the fresh and weathered surfaces. Individual grains that are primary in origin can be observed on the weathered surface of the less recrystallized rocks. In rocks of higher metamorphic grade (amphibolite facies), usually only compositional banding or bedding features aid in the recognition of these rocks. Photo 6 shows compositional variations in rocks interpreted by the author to be turbidites, these occur west of Mallot Lake. The laminations vary from less than 1 to 4 cm thick and have occasional interbeds of coarse conglomeratic units.

Compositionally, the wackes are composed of quartz, plagioclase, biotite, hornblende, chlorite, and accessory sericite, epidote, opaque minerals, and potassium feldspar. The arkoses have essentially the same mineralogy, but lack feromagnesium minerals, in particular, hornblende. The mafic minerals define the foliation and compose from 5 to 30 percent of the rock. In mafic-poor

wackes, the mafic minerals are interstitial. Hornblende is an essential constituent in the wackes, gritty wackes, and conglomerates that have been derived from mafic to intermediate metavolcanics, and is a particularly common constituent east of Alvin Lake and northwest of Union Lake. Biotite is associated in varying amounts with hornblende. Biotite appears to be more commonly associated with wackes that contain a pelitic component than those derived from mafic to intermediate metavolcanics. The wackes containing a pelitic component are more common north of Grey Owl Lake and northwest of Doyle Lake than the wackes derived from mafic to intermediate metavolcanics.

Quartz and plagioclase are usually angular to subangular in rocks of low metamorphic grade, the greenschist facies, and indicate a relatively immature depositional environment. Grain size in wacke and arkose is variable within a given bed, varies from 0.06 to 0.2 mm, and indicates a lack of sorting. North and east of Mallot Lake, the arkosic rocks are composed of subrounded to angular fragments of quartz and feldspar and the grain size is generally smaller (0.04 mm) suggesting that these rocks have been derived from the felsic metavolcanic tuffs. Distinction between arkose and tuff is difficult. Some arkose could have been interpreted as felsic metavolcanic tuffs and vice versa.

SILTSTONE

Siltstone is not common in the map-area. This may be due to poor exposure, and the fact that the depositional environment appears to have been immature and was possibly that of an unstable paleoslope. Siltstone occurrences were noted within the mafic metavolcanics north of the Montreal River, in the wackes within the Alvin Lake Synform, and south of the Montreal River in the western part of the map-area. Siltstone is banded, has laminations varying from 2 to 5 mm in thickness, and is dark grey to grey on the fresh and weathered surface. Minor amounts of sulphides occur within the siltstone south of the Montreal River and may be contemporaneous with banded siltstone-sulphide units that are common in the Cowie Lake Area (Grunsky 1978).

WATERLAIN AND REWORKED METAVOLCANIC TUFFS

Rocks interpreted by the author to be waterlain and reworked felsic metavolcanic tuffs are part of the metasedimentary sequence along the southern bank of the Montreal River. These felsic units are interbedded with the clastic biotite- and hornblende-bearing wackes, and probably represent a transition from a felsic metavolcanic tuffaceous environment to a clastic metasedimentary environment. These rocks are compositionally and texturally the same as the felsic metavolcanic tuffs, but have been grouped with the metasediments because they are part of a metasedimentary environment that becomes increasing clastic westward and southward.

GRAPHITE AND SLATE

Exposures of graphite and slate were not observed in the map-area. Both of these units were recorded in diamond-drill hole logs from the area south and north of Doyle Lake, and are part of syngenetic sulphide deposits that occur within the felsic to intermediate metavolcanics.

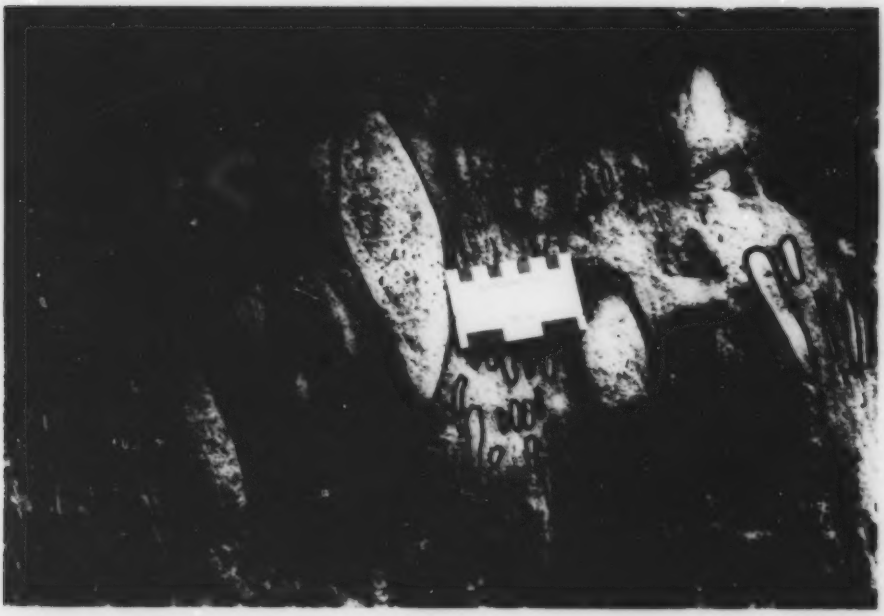
CONGLOMERATE

Conglomerates are major lithologic units that outcrop south of Mallot Lake, northwest of Union Lake, and west of Grey Owl Lake within the Alvin Lake Synform. These three conglomerate localities have essentially the same matrix mineralogy and clast composition. These rocks may be part of the same stratigraphic unit which has been tectonically dislocated by the Grey Owl Lake Fault and the mobilization caused by the felsic intrusive rocks occurring in the southwestern and northern parts of the map-area.

The conglomerates within the map-area have several distinct features in common, these are: variable clast size, clasts of felsic to intermediate metavolcanic composition and texture, a polymodal wacke to arkosic matrix, and associated wacke interbeds.

West of Mallot Lake, the clasts are highly stretched, and the matrix is granoblastic within an almost total anatectic metamorphic environment. The clast shapes, however, can still be clearly observed. Eastward, to the southeast of Mallot Lake, the clasts are stretched. These clasts, however, are not as large as those just described, and approach a texture that is closer to a pebble conglomerate. East of Alvin Lake, large cobbles can be observed within the conglomerates that are the least deformed cobbles in the map-area (Photo 7). The conglomerates grade vertically and laterally into wackes, pebbly wackes, and gritty wackes over several outcrops. Clasts vary in size from a few millimetres up to 20 cm, and appear to vary in shape from angular to rounded and compose 10 to 80 percent of the rock. The clasts are very poorly sorted and indicate immature deposits.

The matrix varies from buff-grey to dark grey on the fresh and weathered surfaces with a polymodal fine to coarse grain size distribution. The conglomerates are essentially polymodal oligomictic paraconglomerates. In the lower metamorphic grade rocks, the matrix grains are commonly angular, and in thin section, the matrix is revealed to consist of angular to subangular quartz, plagioclase, and minor amounts of microcline having interstitial biotite and hornblende. The plagioclase occurs as untwinned crystals, twinned crystals, and aggregates. Quartz varies from 20 to 30 percent, plagioclase 40 to 50 percent, microcline 0 to 5 percent, biotite 5 to 10 percent, and hornblende 5 to 30 percent. Garnet was noted in the matrix in the conglomerates west of Mallot Lake. Hornblende, generally more abundant in the conglomerates, was probably derived from weathering mafic to intermediate metavolcanics. Plagioclase exhibits alteration to sericite in varying amounts, this possibly reflects a variety of compositions of plagioclase. This may be a retrograde metamorphic effect



OGS 10 245

Photo 7–Oligomictic paraconglomerate composed of felsic metavolcanic fragments in a gritty wacke matrix, 1.6 km east of Alvin Lake.

rather than a primary feature. The felsic to intermediate metavolcanic clasts are uniform in texture and identical in texture and mineralogy to the tuffaceous rocks in the Doyle Lake area.

Due to poor exposure, bedding in the conglomerates was not observed, but a gradation from coarse conglomerate to gritty wacke was observed over several outcrops on the northern limb of the Alvin Lake Synform. This gradation indicates that tops are to the south, and suggest that the rocks form a syncline. These conglomerates were probably deposited by submarine turbidity flows since they are associated with other turbidite-like deposits.

GRITTY WACKE AND PEBBLY WACKE

Gritty wacke and pebbly wacke are associated with the conglomeratic units, and may be the upper parts of graded beds in the conglomerates. These rocks are difficult to recognize in areas where metamorphic grade is high. Northwest of Union Lake small felsic clasts become highly stretched and tend to recrystallize into a texture similar to the matrix. South and east of Mallot Lake good exposures clearly exhibit clasts. The fragments and matrix grain size varies, indicating a polymodal clast grain size distribution. The clasts are

typically fine-grained felsic to intermediate metavolcanic fragments, and are similar to the clasts in the conglomerates. The matrix is commonly gritty. The rock is grey to buff on the weathered surface, and is light grey to grey on the fresh surface. In thin section, the mineralogy and texture of the rock is revealed to be identical to that of the conglomerates with angular to subrounded fragments varying from 0.5 to 1.0 cm across and compose 1 to 30 percent of the rock. Garnet is a common constituent in these rocks northwest of Union Lake.

FELSIC INTRUSIVE ROCKS

Foliated Felsic Intrusive Rocks

The foliated felsic intrusive rocks compose nearly one half of the map-area and represent a phase of felsic plutonism and associated anatexis of the Batchawana Belt. These foliated plutonic rocks are extensive to the north and east of the map-area, and have been classified as gneissic granodiorite, trondhjemite, quartz monzonite, and migmatite with a neosome of granitic composition (Thurston *et al.* 1977). The migmatites are variable in their occurrence. These rocks range from metatexite to diatexite in the metasomatic phases of plutonism, to agmatitic, clearly intrusive phases near the intrusions themselves.

The foliated felsic intrusive granitic rocks are composed of trondhjemite, granodiorite, and syenodiorite according to the classification by Ayres (1972) and grade into migmatized supracrustal rocks over a considerable distance. Pegmatites are common within the migmatites but less common in the intrusive plutons. Aplite is restricted only to the intrusive phases. Three main plutons are present in the map-area and are located northwest of Alvin Lake, west of East Lake, and in the Lamb Lake area. Chemical and modal analyses are listed in Table 5. The migmatites occur as a broad band across the northern part of the map-area between the two northern plutons and as a zone that penetrates into the lower metamorphic grade supracrustal rocks north of, and in the Alvin Lake area.

MIGMATITIC GRANITIC ROCKS

The migmatites consist of a quartz-plagioclase-biotite ± hornblende schist and gneiss. These rocks grade from metatexite to diatexite in an irregular pattern across the map-area, but a trend towards a predominantly diatexitic character occurs near the plutons. These rocks grade into the supracrustal rocks south of the Montreal River, and have been classified by the author with the felsic intrusive rocks. This is because of the abundance of neosome mobilizate and the appearance of diatexitic phases that are less common in the supracrustal rocks in the western part of the map-area between Alvin Lake and the Montreal River. The foliation in the migmatites is a vague to pronounced gneissosity. Mafic to felsic banding within a medium- to coarse-grained quartz-

TABLE 5 | **CHEMICAL AND MODAL ANALYSES OF "EARLY" FELSIC INTRUSIVE ROCKS IN THE GREY OWL LAKE AREA.**

MAJOR COMPONENTS IN WEIGHT PERCENT

Sample Number	G-32-327	M-44-337	G-19-210	G-22-229
Point Number	28	29	30	31
SiO_2	65.50	70.60	70.70	72.50
Al_2O_3	18.10	16.00	16.10	15.20
Fe_2O_3	3.08	1.50	2.44	1.53
MgO	1.21	0.77	0.30	0.41
CaO	3.14	1.37	2.86	2.16
Na_2O	5.22	4.40	5.24	4.60
K_2O	1.43	2.83	0.82	1.61
L.O.I.	0.70	0.90	0.40	0.16
CO_2	0.20	0.15	0.14	0.16
TiO_2	0.36	0.19	0.20	0.18
P_2O_5	0.13	0.08	0.01	0.06
S	<0.01	0.04	0.01	<0.01
MnO	0.04	0.04	0.04	0.03
Total	98.91	98.68	99.11	98.44

TRACE ELEMENTS IN PPM

Ba	160	540	170	390
Co	10	5	6	<5
Cr	9	<5	6	<5
Cu	<5	6	10	<5
Li	75	70	30	20
Ni	5	<5	<5	<5
Pb	25	710	<10	10
Zn	60	65	45	40

MODAL ANALYSES (VOLUME PERCENT)

Quartz	24.60	40.00	39.40	40.70
Plagioclase	57.80[1]	44.30[1]	53.80[1]	49.80
Microcline		9.50		6.00
Biotite	17.20	5.90[2]	5.60	3.30
Muscovite		0.20	0.10	
Opaque Minerals		0.10	1.10	0.20
Apatite	0.40			

FOOTNOTES:

[1]Plagioclase and sericite

[2]Biotite and chlorite

NOTES FOR TABLE 5

G-32-327 Trondhjemite, 4.6 km north of narrows of Montreal River, Longitude 84.21787, Latitude 47.36321.

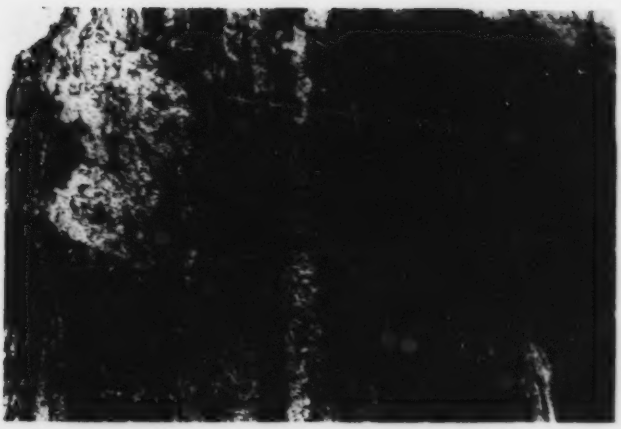
M-44-337 Granodiorite, island along south shore of Montreal River, east part of map-area, Longitude 84.14251, Latitude 47.32699.

G-19-210 Trondhjemite, 1 400 m southwest of Lamb Lake, Longitude 84.11371, Latitude 47.35938.

G-22-229 Trondhjemite, 2 100 m west of Lamb Lake, Longitude 84.13189, Latitude 47.37131.

PLEASE NOTE: CO_2 is included in L.O.I.
S in not included in total

Chemical analyses by Geoscience Laboratories, Ontario Geological Survey



OGS 10 246

Photo 8–Metatexite composed of biotite schist and gneiss intruded by a quartz-plagioclase leucosome (mobilizate) along the northern bank of the Montreal River.

plagioclase-microcline leucosome produce the gneissosity. Development of a biotite-rich melanosome is common in the migmatites (Photos 8 and 9). This suggests that segregation of the minerals occurred during the *in situ* development of the leucosome. The paleosome of the migmatites is commonly grey-brown to grey on the weathered surface and light grey to grey on the fresh surface, with a granoblastic psammitic texture. Quartz, plagioclase, and biotite are all medium grained and subhedral to euhedral. Most of the metatexitic rocks appear to contain *lit-par-lit* injections of neosome caused by partial melting. As the texture progresses to a diatexite, the distinction between the paleosome and the neosome becomes less apparent and schlieren textures develop.

In thin section, the paleosome of the metatexites is composed of quartz (5-30 percent), plagioclase (20-60 percent), biotite (10-30 percent), hornblende (0-

OGS 10 247

Photo 9–Inhomogeneous diatexite showing extensive assimilation of a biotite gneiss similar to the one in Photo 8. Jett Creek Inlet on the Montreal River.

50 percent), and accessory microcline, chlorite, epidote, sericite, and opaque minerals. The texture is granoblastic with subhedral to euhedral crystal shapes. Quartz is generally the largest mineral (up to 2.0 mm across) with plagioclase, biotite, and hornblende having the smallest grain size (up to 1.0 mm). Pseudomorphs of possible cordierite were observed within the metatexites along the Montreal River. Plagioclase crystals interlock and are commonly twinned with a variable amount of alteration to sericite. This is probably a retrograde metamorphic effect. Biotite and hornblende are commonly interstitial within the metatexites, but form porphyroblasts and poikiloblastic aggregates in the melanosome of the diatexites. Hornblende is generally more common than biotite in the east part of the map-area where assimilation of the mafic to intermediate metavolcanics has occurred. Biotite is generally more common than hornblende to the west where the metasediments prevail.

The neosome (leucosome) is generally coarse grained (up to 1 cm across) with an igneous texture. Microcline is not always present. The overall texture and composition of the migmatites grade from a predominantly gneissic supracrustal assemblage into a granitoid composition with an igneous texture. The pegmatites are probably derived from partial melting of the migmatites.

The development of migmatite from metatexite to diatexite is heterogeneous. Large rafts of metatexite can be observed within the diatexites, and local patches to extensive areas of diatexite can occur in predominantly metatexitic domains.

QUARTZ MONZONITE, GRANODIORITE, AND TRONDHJEMITE

Quartz monzonite is not common within the foliated felsic intrusive rocks, and is restricted to a zone composed of migmatite, quartz monzonite, and granodiorite west of Alvin Lake. The quartz monzonite grades into the diatexitic migmatite and granodiorite and it appears to be developed only locally, most probably due to a local phase of potassium enrichment. Quartz monzonite is foliated, equigranular, medium to coarse grained, and light pink.

Granodiorite and trondhjemite are the two most common intrusive phases that grade into the anatectic supracrustal rocks. In places, the boundary between the migmatite and the intrusive phases consists of a zone of agmatitic supracrustal rocks. This zone shows varying degrees of assimilation by the intrusive phase. These rocks are characteristically foliated, and display coarse, elongated aggregates of quartz or the preferred orientation of the platy mafic minerals. Trondhjemite and granodiorite are characteristically light grey to white on the platy weathered surface, and white to very light grey on the fresh surface. The mafic minerals commonly are less than 15 percent of the volume of the rock. The principal constituents of these rocks are quartz (25-40 percent), plagioclase (40-50 percent), microcline/perthite (0-10 percent), and accessory amounts of biotite, hornblende, chlorite, epidote, sericite, and opaque minerals. The texture varies from medium to coarse grained, and is hypidiomorphic granular to porphyritic. Plagioclase is commonly twinned with an average composition of An_{25} and contains variable amounts of sericite. The potassium feldspars are generally interstitial to the anhedral quartz and subhedral plagioclase. Biotite is subhedral and displays brown/green pleochroism, and the hornblende displays dark green/green pleochroism.

SYENODIORITE AND TONALITE

Syenodiorite and tonalite are hybrid felsic intrusive rocks that occur near the boundary with the supracrustal rocks, and occur particularly near the mafic to intermediate metavolcanics. These rocks are medium grained, pink, moderately well foliated, and contain up to 30 percent mafic minerals, but contain less than 10 percent quartz. In the Alvin Lake area, these rocks have probably been derived by anatexis of the adjacent mafic to intermediate metavolcanics. They have probably been derived from a similar source along the north

bank of the Montreal River north of the contact with the mafic to intermediate metavolcanics.

PEGMATITE AND APLITE

Pegmatite is very common throughout the migmatitic rocks north of the Montreal River, and occurs as massive pods and dikes up to 5 m across. The colour varies from light pink to white. The rock is composed of very coarse grained quartz, plagioclase, perthitic microcline, and minor biotite. The potassium feldspar is as much as 5 cm in size. The quartz is generally anhedral, the feldspars euhedral, and biotite is developed as large euhedral books up to 2 cm across, but rarely exceeds more than 1 percent of the rock. The pegmatites are probably related to anatexis and appear to be a late stage intrusive phase that crosscuts pre-existing foliations.

Aplite dikes and veins are restricted to the foliated intrusive plutons, and are late stage intrusions that crosscut the foliation. They are light grey to light pink, medium grained, and generally less than 30 cm wide. Aplite is composed of quartz, plagioclase, and microcline with no mafic minerals present.

Massive Felsic Intrusive Rocks

The massive felsic intrusive rocks are a series of massive stocks that have intruded the supracrustal rocks in the south-central part of the map-area, and are texturally and mineralogically distinct from the foliated felsic intrusive rocks.

The largest of these intrusions is the Grey Owl Lake Stock which is a large microcline porphyritic quartz monzonite intrusion with minor phases of microcline-poor quartz monzonite. Three smaller quartz monzonite stocks occur in the area north of Grey Owl Lake and west of Doyle Lake. All of these intrusions display sharp, discordant contacts, and distinct metamorphic aureoles within the surrounding supracrustal rocks.

Chemical and modal analyses of these rocks are shown in Table 6.

The best exposures of these massive felsic intrusives can be seen along the shoreline of Grey Owl Lake where microcline porphyritic quartz monzonite can be observed. The quartz monzonite is light pink to light pink-grey on the fresh and weathered surface, and is composed of quartz, plagioclase, microcline, and accessory biotite, chlorite, epidote, muscovite, and opaque minerals.

The accessory minerals generally form less than 10 percent by volume. Thin section examination reveals that the texture varies from hypidiomorphic granular to porphyritic with a hypidiomorphic granular matrix. Grain size varies from 0.1 to 0.5 mm. Microcline is the dominant porphyritic mineral; phenocrysts are subhedral to euhedral and vary in size from 1.0 to 3.0 mm. Microcline also occurs as fine interstitial grains. Quartz phenocrysts are common in the east part of the Grey Owl Lake Stock and usually occur in the form of anhedral crystals and interlocking aggregates. Plagioclase occurs as euhedral to anhedral crystals displaying twinning and normal zoning.

TABLE 6 | CHEMICAL AND MODAL ANALYSES OF "LATE" FELSIC INTRUSIVE ROCKS IN THE GREY OWL LAKE AREA.

	MAJOR COMPONENTS IN WEIGHT PERCENT		
Sample Number	G-27-274	M-16-143	M-18-155
Point Number	32	33	34
SiO_2	68.70	70.60	71.10
Al_2O_3	16.60	16.50	16.70
Fe_2O_3	1.94	1.30	1.16
MgO	0.57	0.31	0.33
CaO	1.76	1.40	0.80
Na_2O	4.42	4.51	5.67
K_2O	3.46	4.01	3.33
L.O.I.	0.70	0.60	0.90
CO_2	0.06	0.19	0.13
TiO_2	0.32	0.21	0.23
P_2O_5	0.07	0.04	0.06
S	<0.10	<0.10	<0.10
MnO	0.03	0.04	0.02
Total	98.57	99.52	100.30
	TRACE ELEMENTS IN PPM		
Ba	650	800	540
Co	6	5	<5
Cr	15	9	9
Cu	10	5	<5
Li	10	29	6
Ni	6	<5	<5
Pb	35	34	54
Zn	55	45	23
	MODAL ANALYSES (VOLUME PERCENT)		
Quartz	25.30	27.80	27.60
Plagioclase	65.40[1]	38.10	41.90
Microcline		28.80	26.00
Biotite		2.90	
Chlorite	8.30	1.70	1.90
Muscovite			2.00[2]
Epidote	0.30	0.20	
Opaque Minerals	0.30	0.50	0.60
Sphene	0.40		

FOOTNOTES:

[1]Plagioclase and sericite.

[2]Sericite and muscovite.

PLEASE NOTE:

CO_2 is included in L.O.I.

S is not included in total.

NOTES FOR TABLE 6

G-27-274 Equigranular quartz monzonite, 1 400 m west southwest of Doyle Lake, Longitude 84.15396, Latitude 47.26953.

M-16-143 Microcline porphyritic quartz monzonite, Grey Owl Lake, southern peninsula, Longitude 84.20357, Latitude 47.26286.

M-18-155 Equigranular quartz monzonite, narrows at east part of Grey Owl Lake, Longitude 84.18865, Latitude 47.27053.

Chemical analyses by Geoscience Laboratories, Ontario Geological Surveys

Granodiorite is a potassium-poor phase that was noted in the Grey Owl Lake Stock and is only local in occurrence. The granodiorite has porphyritic crystals of quartz and is lacking in microcline phenocrysts. It has the same colour and texture as the quartz monzonite.

The Grey Owl Lake Stock and related stocks are probably post-tectonic intrusions. The intrusions have deformed and displaced the surrounding supracrustal rocks rather than assimilated them. The contacts with the supracrustal rocks, where observed, are sharp. The contact zone is brecciated in places, and in it, xenoliths of the surrounding metasediments are in a fine-grained quartz monzonite matrix. The chill zone is less than 50 m wide in the intrusion. The intrusions lack any late stage crystallization features such as aplites or pegmatites.

Late Precambrian

MAFIC INTRUSIVE ROCKS

DIABASE DIKES

A large number of Late Precambrian porphyritic and non-porphyritic diabase dikes have intruded the felsic intrusive and supracrustal rocks within the map-area. These dikes are part of a large regional dike swarm (Ayres *et al.* 1971a) trending predominantly N30°W and a swarm of less importance having a trend of N40°E. Both swarms give rise to distinct anomalies on the aeromagnetic map (ODM-GSC 1963). Isotopic age dates of the dikes in the area vary from 1035 to 1450 m.a. (Wanless 1970), and may be associated with dike swarms occurring to the northeast (Thurston *et al.* 1977, p.87). The large regional swarm may be related to the development of the Lake Superior Basin, since many dike swarms within the region of the Lake Superior Basin have been associated with Late Precambrian volcanism (Green 1977; Card *et al.* 1972). The dikes appear to have intruded along major fractures and faults that are probably related to the development of the Lake Superior Basin.

Many more dikes exist in the map-area than could possibly be mapped, and only the larger dikes are shown on the geological map (Map 2446, back pocket). The dikes vary in width from a few centimetres up to 200 m, and display sharp chilled contacts with the surrounding country rock. The dikes commonly bifurcate and coalesce with many of the dikes extending from larger diabase plugs which were probably feeders. Generally, the larger dikes form prominent ridges, particularly in the area around Grey Owl Lake.

In outcrop, the dikes are massive and weather dark grey-brown to dark grey and are dark grey-green on the fresh surface. The texture varies from diabasic to ophitic and is medium grained. The mineralogy consists of plagioclase (An_{45}), augite, hornblende, magnetite, and minor amounts of sericite, saussurite, chlorite, and quartz. Chemical and modal analyses are shown in Table 7. Plagioclase is almost always twinned, euhedral, and displays varying degrees

TABLE 7 | **CHEMICAL AND MODAL ANALYSES OF DIABASE DIKES IN THE GREY OWL LAKE AREA.**

MAJOR COMPONENTS IN WEIGHT PERCENT

Sample Number	M-10-76	G-3-39	G-1-16
Point Number	17	18	19
SiO_2	49.00	49.50	49.50
Al_2O_3	14.40	13.00	14.80
Fe_2O_3	17.00	16.90	13.80
MgO	4.97	4.35	5.66
CaO	9.13	7.86	9.36
Na_2O	2.25	3.51	2.43
K2O	0.67	1.19	1.10
L.O.I.	0.80	1.60	1.50
CO_2	0.31	0.18	0.29
TiO_2	1.70	1.76	0.98
P_2O_5	0.20	0.21	0.11
S	0.13	0.13	0.12
MnO	0.24	0.25	0.20
Total	100.36	100.13	99.44
	TRACE ELEMENTS IN PPM		
Ba	180	240	240
Co	45	45	50
Cr	75	40	135
Cu	140	145	130
Li	15	15	15
Ni	45	35	90
Pb	40	<10	<10
Zn	135	150	100

MODAL ANALYSES (VOLUME PERCENT)

Quartz	1.20		
Plagioclase	36.60	24.80	35.80
Hornblende	5.40	2.80	7.70
Chlorite	1.00	2.40	
Sericite	9.90[1]	31.40[1]	24.80[1]
Opaque Minerals	5.60	7.00	5.20
Augite	40.30	31.60	26.50

FOOTNOTE:

[1]Sericite and Saussurite

NOTES FOR TABLE 7

M-10-76 Medium- grained diabase, 750 m south of Union Lake, Longitude 84.27000, Latitude 47.28267.

G-3-39 Altered diabase dike - Montreal River Narrows, south shore, Longitude 84.21009, Latitude 47.31832.

G-1-16 Partly altered diabase, 900 m west of Mallot Lake, Longitude 84.26275, Latitude 47.30625.

PLEASE NOTE:

CO_2 is included in LOI

S in not included in total

Chemical analyses by Geoscience Laboratories,
Ontario Geological Survey

of alteration to sericite and saussurite. Augite is generally anhedral, and is commonly mantled by hornblende which is in turn mantled by chlorite.

These rocks are classified as high iron tholeiites (Jensen 1976) and their compositions are shown graphically in Figures 2 and 3.

The porphyritic phases contain large subhedral to euhedral, slightly greenish plagioclase phenocrysts up to 2 cm across, and are highly variable in abundance. The porphyritic phases grade into non-porphyritic phases. Glomeroporphyritic phases are common. In some dikes, the glomeroporphyritic phases are aligned parallel to the strike of the contact and are situated in the centre of the dike. These phases suggest that the texture is the result of flow orientation.

Cenozoic

QUATERNARY

Pleistocene and Recent

Pleistocene glaciation has created erosional features in the map-area, these occur most notably south of the Montreal River. Much of the granitic terrain, however, is very rugged and evidence of glaciation is not as obvious. Glacial striae were not observed along the Montreal River, but the river valley itself was probably an area in which glacial outwash was deposited. In the eastern part of the map-area, much terrain close to the Montreal River is covered by sand and gravel which probably represent outwash deposits. In the northern and southern parts of the map-area, the large rounded hills are commonly covered by boulder till and the occasional large erratic. Many of the rugged hills, however, are barren of glacial deposits.

In the area south of the Montreal River, the terrain is hummocky. Glacial striae were observed to be trending west-southwest. Much of this area is covered by swampy, Recent organic deposits.

METAMORPHISM

Regional metamorphism in the map-area varies from middle greenschist to middle amphibolite grade. Hornblende-hornfels contact metamorphism is associated with the post tectonic felsic intrusions (Figure 4).

The lowest grade of metamorphism occurs in the southeastern part of the map-area within the felsic to intermediate metavolcanics east of Doyle Lake. The greenschist facies is defined by the presence of chlorite, zoisite, actinolite, and quartz (Winkler 1976, p.74). A thin unit of mafic metavolcanics in this sequence is composed of magnesium-rich chlorite, actinolite, clinozoisite/zoisite, sericite, carbonate, and iron-rich hornblende. Remnants of pilotaxitic plagioclase microlites in this mafic metavolcanic flow also indicate that the rocks in this area have been subjected to low grade greenschist facies metamorphism.

Northward and westward from the southeast corner of the map-area, the metamorphic grade increases as the contact of the supracrustal rocks with the foliated felsic intrusive rocks is approached. The metamorphic grade also increases as the contact aureoles with the late quartz monzonite intrusions is approached.

As regional metamorphic grade increases the following changes occur; the felsic metavolcanics display an increasing amount of recrystallization and the development of granoblastic textures, the disappearance of chlorite, and an in-

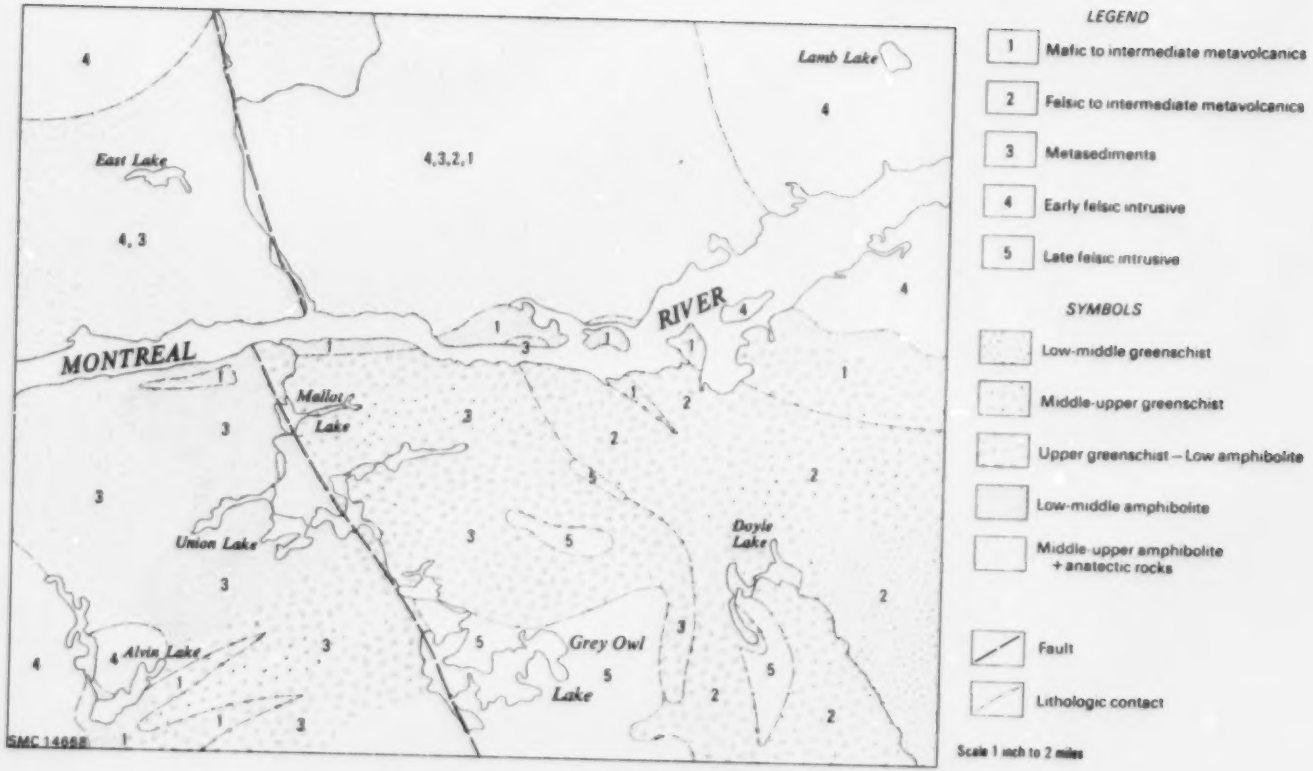


Figure 4–Generalized Metamorphic Zones in the Grey Owl Lake Area.

crease in biotite content. Sericite develops into muscovite. Plagioclase recrystallizes into equigranular and non-twinned subhedral to euhedral grains. The mafic metavolcanics develop uralite/hornblende and the wacke metasediments are composed of biotite and chlorite formed under conditions of middle to upper grade greenschist metamorphism. The areas north of Doyle Lake east of Alvin Lake and southeast of Mallot Lake are predominantly upper grade greenschist facies. Primary macroscopic features are generally well preserved in these rocks, but the microscopic features have been almost completely obliterated.

In rocks of the amphibolite facies, primary features are almost completely obliterated due to extensive recrystallization of the rocks. In the mafic metavolcanics, the amphibolite grade is marked by the development of hornblende and epidote, and the recrystallization of plagioclase. Epidote is not always present. Its absence possibly represents further recrystallization in which the plagioclase incorporates more calcium, and may also indicate a medium pressure environment (Winkler 1976).

The felsic to intermediate metavolcanics do not change much mineralogically from the assemblages developed under middle to upper grade greenschist facies. However, the texture becomes increasingly granoblastic and coarser grained as porphyroblasts of plagioclase develop.

The metasediments also are changed by amphibolite facies metamorphism. The metasediments become increasingly porphyroblastic with biotite and hornblende recrystallizing into larger grains as the fine-grained groundmass recrystallizes.

Garnet was noted in the mafic, intermediate, and felsic metavolcanics, and in the metasediments within the higher grade amphibolite facies rocks. This may be partly the result of the bulk composition in the metasediments, and could also be an indication of high pressure within the metavolcanics (Winkler 1976, p.167).

North of the Montreal River, the metamorphism increases to upper amphibolite grade, and extensive anatexis of the supracrustal rocks has occurred. In the east-central part of the map-area, the mafic to intermediate metavolcanics are generally fine-grained amphibolites along the northern bank of the Montreal River. South of these mafic to intermediate rocks, the underlying metasediments are biotite schists with feldspar porphyroblasts that grade into metatexites within a few hundred metres. In the western part of the map-area, the boundary between the migmatites on the northern bank of the Montreal River and the high grade amphibolite facies metasediments along the southern bank of the river, do not display a distinct "jump" in metamorphic grade. The metasediments of the northern bank and the metasediments on the southern bank of the Montreal River are different. The southern bank metasediments lack the extensive development of a leucosome, this is displayed by the northern bank metasediments. The anatexis occurring to the west may be a result of near-surface intrusions that have penetrated into the metasediments which may have contained considerable water. The mafic metavolcanics probably contained less water, and thus were not as highly metamorphosed. The metavolcanics acted as a barrier to progressive metamorphism into the supracrustal rocks. This effect can be observed in the Alvin Lake area. The metasediments north of Alvin Lake have partly undergone anatexis, but those metasediments overlying the metavolcanics in the Alvin Lake Synform are much lower in metamorphic grade.

Contact metamorphic effects of the massive quartz monzonite intrusions on the metasediments can be observed and felsic metavolcanics around Grey Owl Lake. On the western shore of Grey Owl Lake, biotite schists with porphyroblasts of feldspar are present and indicate albite-epidote facies contact metamorphism. This could be a retrograde effect due to the presence of the Grey Owl Lake Fault. Northeast of the Grey Owl Lake Stock, retrograded staurolite schists were noted. The development of the original staurolite was probably due to the contact metamorphism and medium grade pressure (Winkler 1976). Stictolithic hornblende in the tuffs around Doyle Lake, and the development of garnet within the metasediments around the east part of the Grey Owl Lake Stock, indicate a hornblende-hornfels contact metamorphism at medium grade pressure (Winkler 1976). The contact aureole appears to be less than 500 m wide around the late intrusions.

Many of the supracrustal rocks within the map-area have probably undergone retrograde metamorphism of low grade greenschist facies. This is suggested by; the development of chlorite in the higher-grade metamorphic rocks along the banks of the Montreal River, the presence of retrograded staurolite in the biotite schists north of the Grey Owl Lake Stock, and the alteration of plagioclase to sericite. Within the migmatites north of the Montreal River, possible pseudomorphs of cordierite were observed, and these also suggest retrograde metamorphism took place. Subsequent retrograde metamorphism probably occurred. It may be related to the development of the Lake Superior Basin, and the related faulting and the accompanied development of the Kapuskasing Structure (Thurston *et al.* 1977). This event might possibly have generated enough heat to overprint a low grade metamorphic assemblage on top of the pre-existing regional and contact metamorphic assemblages which developed at the time that intrusion and deformation took place.

STRUCTURAL GEOLOGY

The Grey Owl Lake map-area consists of two structural zones: the supracrustal rocks south of the Montreal River; and the anatectic metasediments and felsic intrusive rocks north of the Montreal River.

The supracrustal rocks south of the Montreal River form a wide arcuate band that is bounded to the north by the Montreal River and the sequence is wrapped around the Grey Owl Lake Stock. This stock has undoubtedly contributed to the arcuate shape of the supracrustal rocks. Sharp discordant contacts as well as the parallelism of schistosity to the intrusive contact indicates that the stock was intruded by displacing the supracrustal rocks, rather then assimilating them. Figure 5 shows a contoured equal area projection of schistosity measurements using the contouring method of Kamb (1959). The measurements were taken in the map-area south of the Montreal River. Two maxima represent the change in the strike of the schistosity around the pluton. This is also exhibited in Figure 6 which displays the change in the strike of the bedding around the pluton.

South of the Montreal River, the foliation of the supracrustal rocks is defined by a moderate to well-developed schistosity caused by the reorientation of

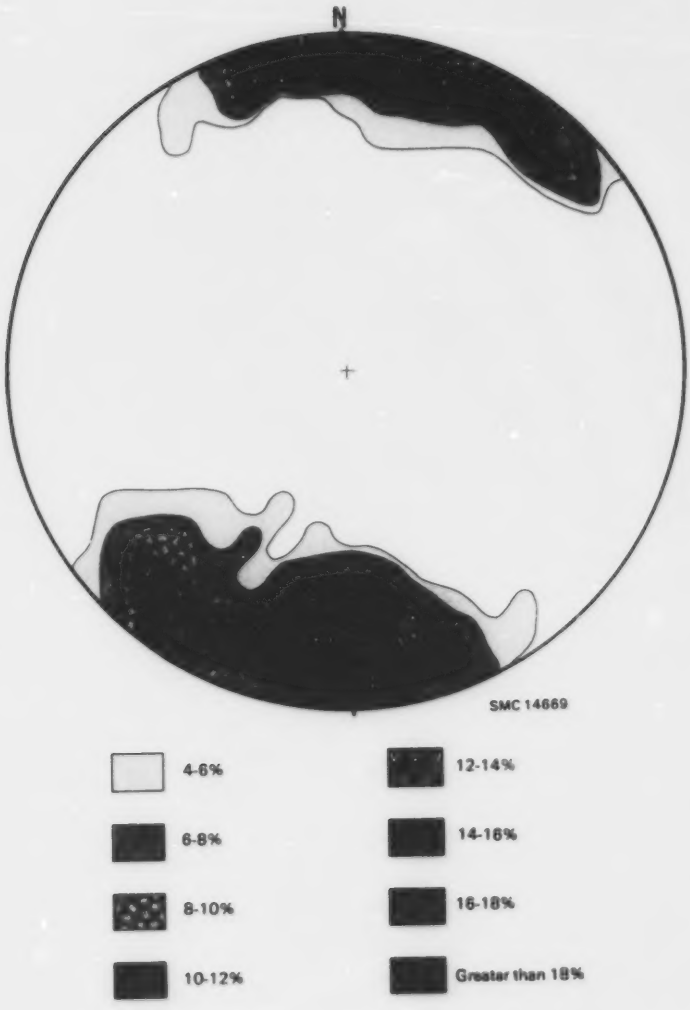


Figure 5–Schistosity Measurements in the Grey Owl Lake Map-Area.

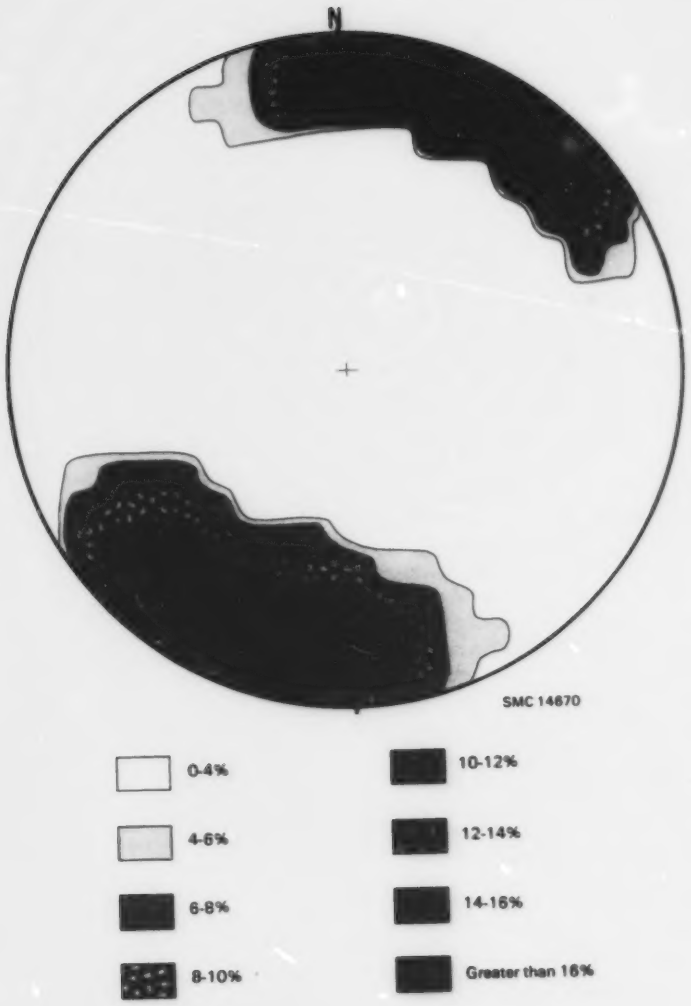


Figure 6–Bedding Measurements in the Grey Owl Lake Map-Area.

the platy minerals biotite, muscovite, and hornblende. Generally, the schistosity is well developed nearer to the felsic intrusive rocks. Gneissosity is developed locally in the west-central part of the map-area where the metasediments have undergone partial melting.

Bedding measurements in the supracrustal rocks south of the Montreal River were found to be parallel to the foliations as shown in Figure 6.

The foliation of the supracrustal rocks south of the Montreal River dips generally subvertically, and averages 75 to 80 degrees. Vertical dips were noted within the felsic to intermediate metavolcanics north and east of Doyle Lake. This area may be part of a syncline that extends eastward from the map-area; insufficient information exists to outline the axis without further investigation to the east.

In the southwest part of the map-area, the Alvin Lake Synform occurs as an isoclinal northeasterly-plunging fold. This fold was outlined by tracing the lithology of the rocks and obtaining structural measurements. An additional antiform may parallel the structure within the south limb of the synform, but not enough structural information is available to confirm this. The Alvin Lake Synform is probably a syncline. This is based on the observation that the sequence in the synform is that of a lower mafic to intermediate metavolcanic sequence which is overlain by coarse-grained clastic metasediments. This interpretation is supported by the presence of what may be gradational bedding of the conglomerates. This "bedding" is visible on outcrops on the northern limb of the synform. In this area, the sequence grades from coarse conglomerate in the north to pebbly wacke in the south. This type of stratigraphy was also observed along the southern bank of the Montreal River, where tops from graded beds indicate that the coarse clastic metasediments overlie the mafic to intermediate metavolcanics.

The stratigraphy of the Alvin Lake Synform is similar to the rocks exposed on the southern banks of the Montreal River, and it is probably the same unit that has been tectonically dislocated by the development of the Grey Owl Lake Fault, the development of which followed the intrusion of the early foliated granitic rocks.

The migmatitic metasediments have developed a pronounced gneissosity that trends roughly parallel to the margin of the lower grade supracrustal rocks along the Montreal River. Gneissosity measurements taken in this area are shown in Figure 7. The measurements reveal that a vertical to subvertical gneissosity prevails trending approximately N75°E. The gneissosity is defined by the following; banding of leucosomes, biotite schistosity in the protometataxitic rocks, and the felsic to mafic banding in the more remobilized migmatites.

The foliation in the trondhjemites and granodiorites north of the Montreal River consists of a parallelism of mafic minerals and quartz that strikes generally at N45°E (Figure 8). This is parallel to the regional lineaments and faults that are possibly related to the development of the Lake Superior Basin and the Kapuskasing Structural Zone.

The Grey Owl Lake Stock contains two prominent joint sets that are shown in Figure 9. One joint set is parallel to the regional foliation of the supracrustal rocks in the eastern part of the Batchawana Belt, and the other set is parallel to the regional faults and lineaments that trend at approximately N45°E.

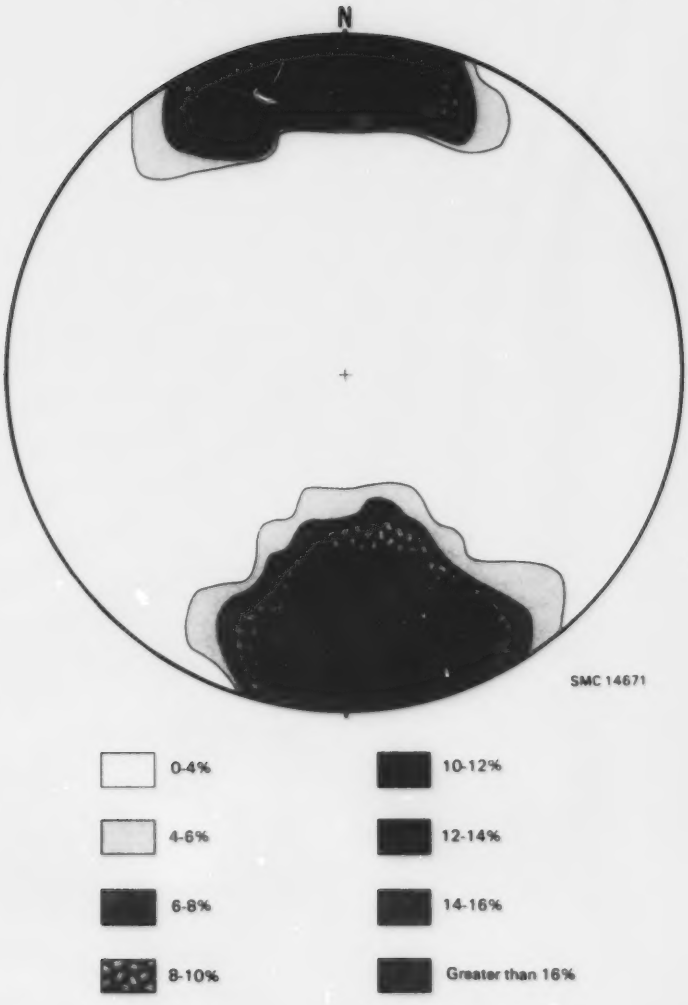


Figure 7–Gneissosity Measurements North of the Montreal River.

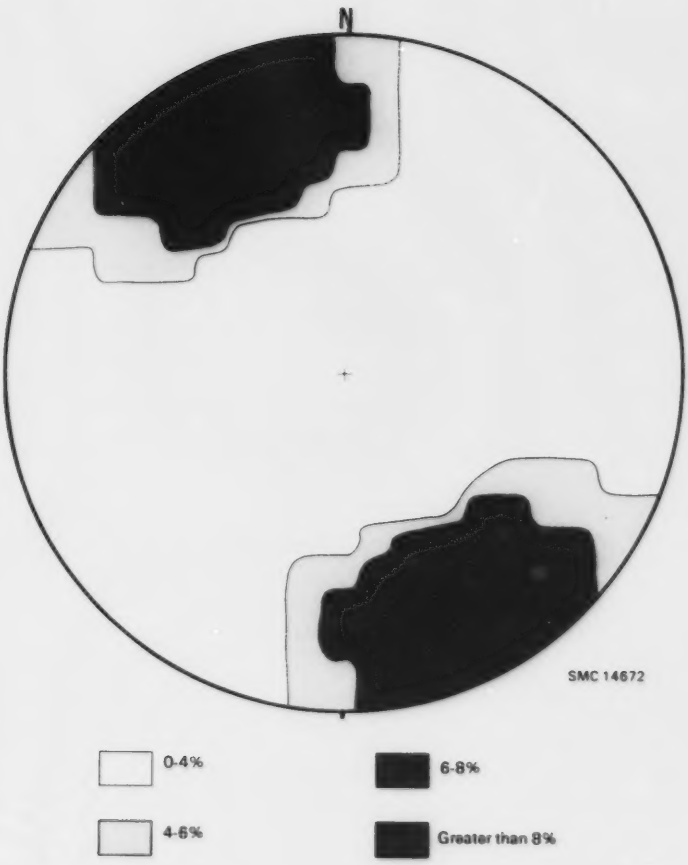


Figure 8–Foliation Measurements North of the Montreal River.

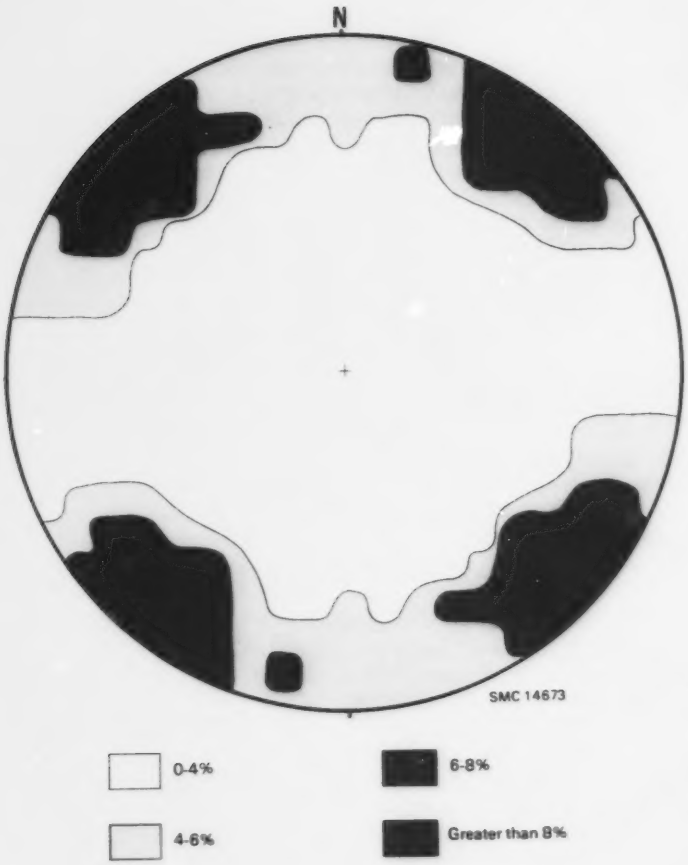


Figure 9–Joint Measurements in the Grey Owl Lake Stock.

Top determinations in the map-area were restricted to only a few outcrops within the supracrustal rocks. Within the mafic metavolcanic sequence near the southern bank of the Montreal River, grain size variation from coarse-grained bottoms to chilled, fine-grained, sheared flow tops were observed. Northwest of Doyle Lake, within the felsic to intermediate metavolcanic tuffs, graded beds, 0.5 to 2 cm thick, were noted. In these graded beds, coarse crystals of feldspar are present in the lower parts of beds that contain fine-grained tops. The beds within this area are overturned. Overturned graded beds were observed in wackes within the metasedimentary succession along, and south of the Montreal River bank. Generally, the metamorphism in the map-area has obliterated most textural features that indicate bedding tops.

In the west-central part of the map-area, schistosity is highly irregular. Many of the wacke/turbidite units give the appearance of having undergone flow folding at the time of metamorphism. The irregularity of the bedding/-schistosity relationship may be partly due to a flow folding effect generated by partial melting which may be caused by an intrusive complex that is below the sequence. The supracrustal rocks become assimilated into the migmatitic rocks to the west of the map-area. The area west of Mallot Lake may be underlain by a thin sequence of supracrustal rocks resting on a felsic intrusive complex. Except for the eastern part of the supracrustal sequence and the Alvin Lake Synform, the rocks have apparently been overturned; beds dip to the north and tops face south.

Faults and Lineaments

Many large regional faults and lineaments exist within the Grey Owl Lake map-area.

Many of the lineaments were interpreted from air photograph examination and are most likely faults or fractures. These features were not identified as faults due to a lack of field data. The lineaments strike in three prominent directions, N10° to 30°W, N50°E, and E-W.

Lithologic contacts are commonly oriented N30°W and due east. The N10° to 30°W lineaments are regional and can be traced for several kilometres to the northwest and to the southeast of the map-area, and are parallel to the regional strike of the eastern Batchawana Belt. Diabase dikes were commonly emplaced along the lineaments. Evidence of faulting was revealed by the presence of localized shear zones in some places.

Lineaments trending N50°E are generally more common within the supracrustal rocks and appear to be displaced by the N10°W to 30°W lineaments and faults. The lineaments south of the Montreal River tend to curve into east-trending lineaments, particularly in the Union, Dyer, and Mallot Lake areas. In these areas, the lineaments tend to parallel lithologic boundaries. North of Union Lake, a lineament is filled with smoky quartz veins and is probably a fracture zone that is an offshoot of the Montreal River Fault.

East-trending lineaments were noted north of Atomic Lake and north of Grey Owl Lake and are parallel to the east trend of the Montreal River Fault. Field evidence and airphoto interpretation suggest that these lineaments and

faults have been displaced by the apparently N10°W to 30°W striking faults and fractures that were reactivated at a later date. In the supracrustal assemblage, these east-trending lineaments are part of the contact between lithologic units.

The Montreal River Fault is part of a very large lineament fracture system that is Late Precambrian in age. It extends northeastward into the southern boundary of the Kapuskasing Structural Zone and westward in the Lake Superior Basin. Thurston (geologist with Ontario Geological Survey, personal communication 1979), believes that the two major crustal features expressed by the mid-continent gravity high are related and revealed by an extensive fracture network. The fault occurs along the boundary between the early felsic intrusive rocks and the supracrustal succession. The boundary is most likely a zone of weakness that is easily faulted. Evidence of faulting is uncommon, and is present only in the east-central part of the map-area near the northern bank of the Montreal River between the northern bank "mainland" and an island. Fault gouge, breccia, and quartz veining were observed in this area. Movement along the fault is apparently small, probably less than 500 m along strike. The movement is right handed, as determined from the displacement of lineaments and supracrustal lithologies north and south of the Montreal River. The amount of dip slip, if any, is unknown, but is probably not great.

The northwest-striking Grey Owl Lake Fault is traceable from south of the map-area northward to the Montreal River where it is displaced about 500 m by the Montreal River Fault. The Grey Owl Lake Fault continues north of the river for several kilometres to the northwest along the Jeff Creek inlet beyond the northern boundary of the map-area. It developed after the intrusion of the Grey Owl Lake Stock. The movement is left handed and strike-slip displacement along the shore of Grey Owl Lake is approximately 2000 m. The amount of vertical slip is unknown; the slip may also be rotational. Two faults occur in the eastern part of the map-area within the supracrustal rocks, parallel to the eastern strike of the Montreal River Fault at N50°E. One fault occurs along the southern bank of the Montreal River that exhibits left-handed movement with a strike slip component of about 600 m.

Another fault occurs northeast of Doyle Lake and extends past the eastern map-area boundary. Minor shearing was exhibited along the shore of a lake near the eastern boundary of the map-area. The amount of displacement is unknown.

The faulting in the Grey Owl Lake area is probably due to the development of the Lake Superior Basin and/or the Kapuskasing uplift. Large northeasterly-, and easterly-trending faults and fractures are common in this region of the Batchawana Belt (Giblin, Leahy, and Robertson 1980; Grunsky 1980; and Giblin and Leahy 1967) and are probably the result of readjustment to stress in the earth's crust during Late Precambrian time. The only northwesterly-trending lineaments that are parallel to the foliation in the eastern part of the Batchawana Belt appear to have been activated as faults during or after Late Precambrian time.

CORRELATION OF GEOLOGY AND GEOPHYSICS

The Grey Owl Lake map-area is covered by ODM-GSC Map 2203G (ODM-GSC 1963) published at a scale of 1:63 360. Additional aeromagnetic maps are available from the Assessment Files Research Office, Ontario Geological Survey, Toronto. These maps were prepared for the Algoma Central Railway by F.R. Joubin and Associates Limited in 1962 during preparation for mineral exploration. These maps cover Algoma Central Railway Townships Raaflaub and Runnalls at a scale of 1:1000.

The most distinct aeromagnetic features in the map-area are elongated magnetic highs outlining most of the larger diabase dikes. These highs overprint the magnetic outline of the supracrustal and felsic intrusive rocks. Intense anomalies outline the magnetite ironstone on the eastern boundary of the map-area and south of Mallot Lake.

The lithologies of the supracrustal rocks are not aeromagnetically distinct from each other, but the mafic to intermediate metavolcanics display a slightly higher magnetic regional susceptibility than the other rock types. The felsic to intermediate metavolcanics and metasediments are characterized by a lower magnetic susceptibility relative to the mafic metavolcanics and the diabase dikes.

The Grey Owl Lake Fault is expressed as an elongated magnetic low. Interference by the magnetic overprint of the diabase dikes has caused the magnetic expression of the Montreal River Fault to occur as a series of rounded depressions along its length.

The felsic intrusive rocks south of the Montreal River are expressed as magnetic lows, however, the overprint of the diabase dikes makes the exact outline of the bodies difficult. North of the Montreal River, the magnetic expression is irregular. This irregularity is partly due to the heterogeneous nature of the migmatites and the overprint of the diabase dikes.

Generally, it appears that magnetic features parallel to the diabase dike trend can be distinguished from each other, but lithologies crossing the magnetic trend of the diabase dike at high angles are very difficult to delineate. The exception to this is the magnetite ironstone units that have a much higher magnetic expression than the diabase dikes.

STRATIGRAPHIC SYNTHESIS OF THE EARLY PRECAMBRIAN METAVOLCANIC- METASEDIMENTARY SUCCESSION

The Grey Owl Lake map-area has been interpreted by the author as a distal facies sequence of supracrustal rocks that have been subjected to metamorphism and deformation. These rocks probably represent the marginal facies of supracrustal rocks that occur at the extremes of the supracrustal sequence.

The lowermost unit of supracrustal rocks within the map-area, the mafic to intermediate metavolcanics, is underlain by foliated trondhjemite and granodiorite north of the Montreal River in the east-central part of the map-area. A zone of migmatitic metavolcanics, approximately 500 m thick, extends north-

ward into the felsic intrusive terrain. The zone consists of very coarse grained hybridized trondhjemite containing approximately 40 percent hornblende. Northward, the felsic intrusive rocks grade into foliated trondhjemite and granodiorite with metatexitic to diatexitic hornblende- and biotite-bearing migmatites that have been generated by partial anatexis of the mafic metavolcanic sequence. This lower mafic to intermediate metavolcanic sequence contains a unique marker horizon of banded chert and magnetite ironstone that is present within the lowest metavolcanic sequence in the eastern part of the Batchawana Belt (Grunsky 1978; Siragusa 1978a,b). This unique marker horizon aids in making a stratigraphic interpretation of the map-area. Even though the correlation is complicated by structure, the marker unit aids in the reconstruction of facies relationships, and has been observed around most of the Batchawana Belt perimeter (Giblin *et al.*1980). This unit defines the lowest unit in the volcanic pile within what appears to be an Early Precambrian Basin. The metavolcanic sequence in the Grey Owl Lake area is probably the extreme distal facies of the volcanism which affected the eastern part of the Batchawana Belt. The metavolcanic sequence in the map-area thins westward and grades into metasediments near the western boundary of the area. At this location, these rocks are underlain by distal facies sediments that are probably equivalent to the earliest metavolcanics and weathering products of the Early Archean terrain. Only one cycle of metavolcanics exists which is correlative with the Cowie Lake lower cycle (Grunsky 1980). These metasediments are predominantly wackes and arkoses that have undergone anatexis and extend into the northwest part of the map-area. These migmatitic biotite-rich gneisses grade easterly into hornblende and biotite migmatites and may represent the remnants of a facies change between the metasediments and the metavolcanics.

The mafic to intermediate metavolcanic sequence in the eastern part of the map-area, is overlain by a sequence of distal facies felsic to intermediate metavolcanic tuffs. This sequence is also a characteristic unit that can be traced southeasterly along strike as far as the Cowie Lake area, and it overlies the earliest cycle of mafic to intermediate metavolcanics (Grunsky 1980; Siragusa 1978a,b). In the Cowie Lake area, these felsic to intermediate metavolcanics are proximal and probably close to a volcanic vent; but the metavolcanics become increasingly distal in nature to the northwest in the area of Doyle Lake. In the Grey Owl Lake map-area, the tuffs thin northward toward the Montreal River. At this locality, the tuffs grade into possible reworked tuffs interbedded with clastic, wacke-like metasediments. This represents the furthest extent of the felsic metavolcanics in the eastern Batchawana Belt.

The area west of the felsic to intermediate metavolcanic tuffs is the most northerly extent of the sedimentary supracrustal deposits in the Batchawana Belt. These deposits consist of predominantly metawackes, metapelites, and metaconglomerates which extend westward and overlie the mafic to intermediate metavolcanics, and form a thick succession that probably overlapped onto an Early Precambrian crust. These metasediments are weathering products of the pre-existing mafic to felsic metavolcanics. The metasedimentary gneisses north of the Montreal River are most probably part of the supracrustal metasedimentary assemblage. Plutonism is complex, and a lack of understanding exists about deformation and assimilation along the margin of the Batcha-

wana Belt. These factors make it difficult to prove that these migmatized metasediments either predate or are equivalent to the metasediments along the southern bank of the Montreal River. The western boundary of the supracrustal rocks is complex and the stratigraphic correlation is unclear, but the author believes that the Alvin Lake Synform is possibly a continuation of the lowermost mafic to intermediate metavolcanics. If this is the case, then, the metasediments along the south bank of the Montreal River have undergone a complex and extensive tectonic displacement. This displacement is partly related to the emplacement of the early felsic intrusive rocks, and is partly caused by faulting which post-dates the Grey Owl Lake Stock.

ECONOMIC GEOLOGY

Mineral exploration in the Grey Owl Lake area was first reported in the early 1950s when an uranium occurrence was discovered along the north bank of the Montreal River. Since that time only one major investigation for economic minerals has been carried out, this was done by the Algoma Central Railway during the 1960s. Almost all of the exploration within the map-area has focused on base metals.

A list of assessment work reports is shown in Table 8. These assessment work reports are on file at the Assessment Files Research Office, Ontario Geological Survey, Toronto, and duplicate copies are stored in the Resident Geologist's Office, Ontario Ministry of Natural Resources, Sault Ste. Marie. Additional information is also available from the Algoma Central Railway in the form of geophysical and geological maps of lands held by the company. All of the Algoma Central Railway assessment reports are on file in the Assessment Files Research Office in Toronto and the Resident Geologist's Office in Sault Ste. Marie.

There are no past or presently producing mines within the map-area.

Base Metals

Base metal occurrences in the map-area are restricted to the supracrustal rocks south of the Montreal River, and are found within the felsic to intermediate metavolcanics and the metasediments. In the Doyle Lake area, several base metal occurrences have been located within felsic to intermediate metavolcanic tuffs, lapilli-tuffs, and interbedded metasediments. These rocks are probably syngenetic sulphide units, and have a fumarolic or chemical origin. These occurrences consist primarily of pyrite, pyrrhotite, and minor chalcopyrite with trace amounts of gold and silver. Numerous small showings exist around Doyle Lake.

The felsic to intermediate metavolcanic sequence in the map-area is interpreted by the author as a volcanic facies distally located with respect to the source of the volcanic material.

The base-metal occurrences within the metasediments occur near the con-

TABLE 8 | SUMMARY OF ASSESSMENT WORK LOCATED IN THE ASSESSMENT FILES RESEARCH OFFICE AND RESIDENT GEOLOGIST'S OFFICE, SAULT STE. MARIE.

DATE	COMPANY	FILE	TOWNSHIP	TYPE OF WORK	MINERALIZATION	ASSAY	DESCRIPTION
ca.1952	J.E. Gimby	MRC #9 SMDR 63A, 506	McAughey	Prospecting	U3O8, po	R	Associated with faulting & diabase dike
1953	Jalore Mining Co. Ltd.	SSM 1269	McAughey McParland Runnalls Running	ABMAG	Ironstone diabase dikes	NR	Regional survey
1956	Technical Mine Consultants	SSM 1211 ACR PI	Running	ABEM		NR	Regional survey
1960	Algoma Central Railway	SSM 804 SSM 1003 ACROI	Runnalls	Mapping		NR	Grey Owl Lake
1961	Algoma Central Railway	SSM 874 ACRNJ 63A498 ACRNI	McParland	Mapping, Mag. E.M.		NR	Banded ironstone in NE McParland Township extension of ironstone from McAughey Township
1961	Algoma Central Railway	SSM801 SSM875 63A498 ACRNI	McAughey	mapping, mag, E.M.	IF, py	NR	See ACR NI-banded ironstone in SE McAughey Township
1962	Algoma Central Railway	SSM 803 SSM 889 SSM 804 ACR OI	Loach Runnalls	Mag, E.M. Mapping	IF, py	NR	2 occurrences near Mallot L. py in zone 3 m wide, 100 m long IF in zone 500 m long, 16 m wide

Continued on next page.

8	1961	Algoma Central Railway	SSM 803 SSM 889 ACRON ACRNE	Loach	Mapping	Quartz veins & gossan	NR	Regional Mapping
	1961	Algoma Central Railway	SSM 1001 ACROH	Raaflaub	Mapping		NR	Regional Mapping
	1962	Algoma Central Railway	SSM 898	Montreal R. Lakeshore	Mapping		NR	Detailed description of Montreal R. shoreline
	1962	Algoma Central Railway	SSM 1006 63A 499 ACROJ	Running	Mapping		NR	Regional mapping
	1962	Algoma Central Railway	SSM 1003 63A 499 ACROI	Runnalls	Mapping	Porphyritic quartz monzonite Building stone	NR	Grey Owl Pluton Examined for building stone characteristics
	1961	Algoma Central Railway	SSM 804 SSM 1003 ACR OI	Runnalls	Mapping		NR	Regional mapping
	1962	Algoma Central Railway	SSM 804 SSM 1003 ACR OI	Runnalls	Mapping, E.M. Mag Trenching	py, tr. Au	NR	Gossan east of Doyle Lake 100 m wide, 400 m long
	1964	Algoma Central Railway	Sault Ste. Marie ACR office	Loach McAughley McParland Raaflaub Runnalls Running	Maps-Regional ABEM & ABMAG Pleistocene Geology Bedrock Air Photo Interpretation		NR	Maps Prepared by F.R. Joubin available from ACR office 18 conductors outlined

1964	Rio Tinto Canadian Exploration Ltd.	63.1309 SSM 638 SSM 668 63A. 499 SSM 1003 ACR OI	Runnalls	ABEM, Mag Ground Mag, E.M. Gravity Trenching & Mapping	py, po, cp, tr. Au	R	Several sulphide occurrences in the Doyle L. vicinity 19 conductors outlined 14 followed up
1974	Asarco Exploration of Canada Ltd.	SSM 1755	Running	ABEM		NR	Part of regional survey concentrated east of map-area
1966	Canex Aerial Expl. Ltd.	SSM 1011	Runnalls	Diamond Drilling 50.3 m	py	R	Trace py in 3 zones
1975	Geophysical Engineering Ltd.	SSM 1827 DHIO	Runnalls	Mapping Diamond drilling 37.6 m	py, po	R	Surface samples
1975	Geophysical Engineering Ltd.	SSM 1827 DH 11	Runnalls	Mapping drilling 39.6 m	py, po	R	No surface samples

NOTES FOR TABLE 8

Files prefixed with "SSM" are located at the Resident Geologist's Office, Sault Ste. Marie.

Files prefixed with "ACR" are files located in Sault Ste. Marie and in the Assessment Files Research Office, Toronto, and are part of a group of files that are filed under work done by the Algoma Central Railway.

SMDR - Source Mineral Deposit Record - Geoscience Centre Data Files. Ontario Geological Survey, Toronto.

MRC # 9 - Mineral Resource Circular #9, Uranium and Thorium Deposits of Northern Ontario, by J.A. Robertson, Ontario Department of Mines, 1968.

Abbreviations
ABMAG - Airborne magnetometer survey
ABEM - Airborne electromagnetic survey
Mag - Magnetometer survey
EM - Electromagnetic survey
Au - Gold; IF - Iron Formation; py-pyrite; po - pyrrhotite.
NR - not reported
R reported - see text for property descriptions

tact with the mafic to intermediate metavolcanics along the southern bank of the Montreal River, however, these occurrences appear to consist primarily of pyrite that is associated with banded chert and magnetite ironstone. Other occurrences within the metasediments are located near the felsic intrusive rocks. West of Alvin Lake, only pyrite has been found, however, at the south end of Redcliff Lake, some copper has been reported with some pyrite and pyrrhotite near the contact with the Grey Owl Lake Stock.

Northeast of Doyle Lake, sulphides have been reported in rocks overlying the banded chert and magnetite ironstone unit. This area, however, has never been fully investigated, and might warrant further work.

During the 1960s, the Algoma Central Railway routinely sampled quartz veins for gold, but nothing of significance was reported. Minor amounts of gold and silver have been reported in occurrences within the syngenetic sulphides. During the course of field work, the author sampled a smoky quartz vein to the west of the southwestern part of Doyle Lake. The sample, submitted for assay to the Geoscience Laboratories, Ontario Geological Survey, contains 0.54 ounce of silver per ton and traces of gold.

The quartz veins usually strike east to N50°E, and are parallel to the lineaments and faults associated with the development of the Montreal River Fault.

Iron

Iron occurs as banded chert and magnetite ironstone in the east part of the map-area and is reported (see section on Algoma Central Railway [1962]), but not observed by the author, to occur just east of Mallot Lake. The ironstone in the eastern part of the map-area occurs near the bottom of the mafic to intermediate metavolcanic sequence. The ironstone appears to be discontinuous, because the rock was deposited in basin-like features or because the rock suffered tectonic dislocation. The chert/ironstone contains many interbeds of wacke metasediments that have been derived from the underlying mafic to intermediate metavolcanics. Examination of ironstone exposures indicates approximately 50-60 percent magnetite in layers that vary from less than 1 mm to 3 cm thick, and which are intercalated with thicker cherty layers. This ironstone is probably contemporaneous with the Goulais River Iron Range of the Cowie Lake area (Grunsky 1980), and represents a period of quiescence that resulted in the accumulation of chemical metasediments after the initial phase of volcanism in the Batchawana Belt.

The amount of iron in the unit is probably less than 25 percent, and because the unit is relatively thin (less than 50 m) and discontinuous, it is not currently of economic interest.

Uranium

Uranium occurrences have been noted in the area around Montreal River Harbour and eastward along fractures and zones adjacent to diabase dike contacts. An occurrence of uranium occurs along the Montreal River Fault that

may be partly related to a nearby diabase dike, and the fault zone which the dike cuts. The large regional fractures and faults may be potentially good hosts for those types of deposits that are related to the development of the Lake Superior Basin.

History of Mineral Exploration[1]

The earliest record of mineral exploration in the map-area is dated about 1952 when J.E. Gimby reported the discovery of uranium mineralization in the southwest corner of McAughey Township along the northern bank of the Montreal River. Gimby reported assay values of 0.065 and 0.081 percent U_3O_8 from two grab samples. However, no further work was reported, and currently the area is unclaimed.

In 1953, the Jalore Mining Company, Limited, conducted an airborne magnetic survey over much of the Batchawana Belt in order to locate base-metal deposits. Several magnetic anomalies were investigated by ground follow-up, however, these anomalies were found to be diabase dikes or banded chert and magnetite ironstone. No further work was recorded in the files.

Technical Mine Consultants carried out in 1956 a low frequency airborne electromagnetic survey over six townships within the Batchawana Belt, excluding lands controlled by the Algoma Central Railway. Part of their survey covered Running Township, however, nothing of significance was recorded in the files.

From 1960 to 1964, the Algoma Central Railway carried out an extensive exploration program over the townships that this company controlled. In association with F.R. Joubin and Associates, the area was investigated by a program that included airborne electromagnetic and magnetic surveys, ground electromagnetic and magnetic surveys, and geological mapping. The results were published in maps and reports, and these are available from the Algoma Central Railway in Sault Ste. Marie. From 1964 to 1967, Rio Tinto Canadian Exploration Limited, in association with H.O. Seigel and Associates, through an option with the Algoma Central Railway, carried out an extensive exploration program on the railway's lands and staked 107 claims in the felsic to intermediate metavolcanics within the map-area in Runnalls Township. Airborne electromagnetic and magnetic surveys, ground electromagnetic, magnetic and gravity surveys, geological mapping, and trenching were performed over the anomalies. Ground follow up work occurred on 14 conductors; however, only six were considered to be of significance.

In 1966, Canex Aerial Exploration Limited drilled one of these occurrences northwest of Doyle Lake.

Asarco Exploration Company of Canada Limited, 1974, conducted an exploration program in Running Township, but nothing of significance was re-

[1]Unless otherwise stated, data was obtained from the following sources: Assessment Files Research Office, Ontario Geological Survey, Toronto; the Resident Geologist's Files, Ontario Ministry of Natural Resources, Sault Ste. Marie; and the Lands and Forest Division of the Algoma Central Railway, Sault Ste. Marie (see Table 8).

ported within the map-area. However, east of the map-area numerous occurrences were located, and some diamond drilling was carried out.

In 1975, Geophysical Engineering Limited diamond drilled two holes in the Doyle Lake area. The diamond drill holes were located in sulphide occurrences in the felsic metavolcanic tuffs; no economic mineralization was reported.

Table 8 lists the mineral occurrences in the map-area. The table summarizes the work done and the mineralization reported in the map-area. In the "Descriptions of Occurrences", these occurrences are grouped under the company that performed the work.

As of December 31, 1978, there were no surveyed or unsurveyed claims within the map-area.

Description of Occurrences

ALGOMA CENTRAL RAILWAY [1962] (1)

In the period 1960 to 1962, the Algoma Central Railway had several prospecting parties investigate the economic potential of its lands, and subsequently, a few occurrences were discovered and reported. Prospecting was conducted over Loach, McAughey, McParland, Runnalls, Running, and Raaflaub Townships, and the notes from these surveys are on file (see Table 8). Quartz veins were routinely sampled, however, none were reported to have any economic mineralization. Sulphide occurrences were investigated by using airborne geophysical and ground geophysical and geological methods by F.R. Joubin and Associates Limited, in association with H.O. Seigel and Associates Limited.

The occurrences discussed under this heading are those that had no further work performed on them after their initial investigation. Other sulphide occurrences were optioned to Rio Tinto Canadian Exploration Limited, or were investigated by later interests which will be discussed under the company that carried out investigations most recently.

Mallot Lake-North [1962]

Minor amounts of pyrite occur in sheared reworked metavolcanic tuffs and clastic (wacke) metasediments that overlie a mafic to intermediate metavolcanic sequence. This occurrence occurs near a small pond just north of Mallot Lake. The pyrite occurs as disseminated grains within the shear zone, however, no assay information is available about the occurrence. The zone is approximately 8.0 m wide and 100 m long, is conformable with the regional east-west strike, and dips vertically. The anomaly was located by an airborne geophysical survey. In 1963, however, ground geophysical surveys and geological mapping did not yield any additional information. No further work is on record.

Mallot Lake-East [1962]

In 1962, a banded chert and magnetite ironstone unit was located in the field using the results of an airborne geophysical survey performed by F.R. Joubin and Associates Limited. The ironstone sequence strikes east for about 500 m and dips vertically with a maximum width of 16 m. The ironstone is too lean to be of economic significance as a source for iron. The unit is aeromagnetically distinct (ODM-GSC 1963). However, the author failed to locate any outcrops of this unit during the current survey. No further work was recommended on this anomaly in the report.

Grey Owl Lake [1962]

The Grey Owl Lake porphyritic quartz monzonite was examined for its buildingstone characteristics in 1962. The Algoma Central Railway (see Table 8) report stated that although the rock polished well, the presence of hematite, ilmenite, and the fractured nature of the feldspar crystals made the rock unsuitable as a buildingstone.

Doyle Lake - East [1962]

Geological mapping during 1962 led to the discovery of a rusty sulphide zone approximately 100 m east of the southeast end of Doyle Lake. The mineralization consists of disseminated to semi-massive pyrite located in a zone approximately 100 m wide and 130 m long in strike length within wacke metasediments, and felsic metavolcanic tuff and lapilli-tuff. The zone strikes northwesterly and dips about 60 degrees to the east. A grab sample taken during 1962 indicated only a trace of gold. A trench was located during the course of field mapping by the author and assistants. No information is available on this trench which is about 2 m long. The trench occurs in metasediments and displays disseminated blebs of pyrite. No further information on this "occurrence" is available.

McAughey Township - Southeast [1962]

A unit of banded chert and magnetite ironstone was located using an airborne geophysical survey done by F.R. Joubin and Associates in 1962.

Ground geophysical follow-up work showed that the ironstone strikes approximately east and dips vertically. The chert-ironstone unit is interbedded with mafic to intermediate metavolcanics, and is intercalated with metavolcanic-derived wacke interbeds. The ironstone unit is at least 6 km in length, and is aeromagnetically distinct (ODM-GSC 1963). However, this unit appears to be discontinuous, because deposition probably occurred in basin-like fea-

tures separated from each other or because of tectonic dislocation. The thickness of the unit could not be determined by the author due to poor outcrop exposure. However, the unit is probably at least 30 m thick, and may be as great as 50 m thick. The chert-magnetite banding forms laminae less than 1 mm thick and can be as much as 30 cm thick. The chert usually forms the thicker beds. Ironstone bands consist mainly of magnetite and amphibole (grunerite?). The amount of magnetite varies from 50 to 60 percent of the rock. No samples were submitted for assay. The ironstone is not of economic interest at the time the survey party was active during 1978. Near the top of the ironstone unit, at the east end of the map-area, a zone of pyrite mineralization is recorded in the files, but its exact location could not be located by the author. The zone was reported in the files to be approximately 2.0 m thick, and to be conformable with the underlying magnetite ironstone. A grab sample was collected by the Algoma Central Railway survey crew; however, no assay results were reported in the files.

No further work was performed; however, this zone has not been fully investigated and may warrant further work.

CANEX AERIAL EXPLORATION LIMITED [1966] (2)

During 1966, in an option agreement with Rio Tinto Canadian Exploration Limited for the Algoma Central Railway, Canex Aerial Exploration Limited diamond drilled an occurrence on a five-claim group. This claim group had been worked on by Rio Tinto Canadian Exploration Limited in 1964 (see Table 8). The occurrence is situated approximately 1.4 km north-northwest of Doyle Lake and consists of a syngenetic sulphide zone approximately 2000 m along strike and dipping steeply to the northeast. Trenching, by Rio Tinto Canadian Exploration Limited in 1964, indicated assay values of 0.3 percent Cu over 7.6 m, 0.12 percent Cu over 6.1 m, and 0.01 ounce Au per ton over 1.2 m in two places. The mineralization was reported to consist of 5 to 75 percent pyrite and pyrrhotite in felsic to intermediate metavolcanic schists. Subsequent drilling by Canex Aerial Exploration Limited showed that the conductor consists of several sulphide zones ranging from 0.3 to 2.0 m in thickness, and consists primarily of pyrite and pyrrhotite (± percent) in graphitic horizons intercalated with the felsic metavolcanics. No further work was reported and the claims has been allowed to lapse.

GEOPHYSICAL ENGINEERING LIMITED [1975] (3)

Doyle Lake - East

This occurrence is located approximately 200 m east of Doyle Lake and was first investigated in 1962 by the Algoma Central Railway in association with H.O. Seigel and Associates Limited. This investigation followed an airborne geophysical survey performed by F.R. Joubin and Associates Limited. Follow-

up ground geophysical work and geological mapping located a mineralized zone consisting of syngenetic pyrite and pyrrhotite which is approximately 15 m wide, 120 m in length, strikes northwesterly, and dips steeply to the east. The conductor occurs within an unit of felsic metavolcanic tuff and lapilli-tuff. The mineralized zone was trenched and assay values of 0.3 percent Cu and 0.02 percent Ni were reported. In 1964, Rio Tinto Canadian Exploration Limited investigated the occurrence and performed additional geophysical surveys, geological mapping, and trenching; however, nothing of additional significance was noted.

Geophysical Engineering Limited, in 1975, held four claims on the abovementioned mineralized zone, and diamond drilled the occurrence for a length of 39.6 m. Mineralization was intersected at a length of 9.1 m, and consisted of massive to semi-massive pyrite and pyrrhotite which composed up to 30 percent of the zone. Within this zone, over a length of 1.7 m, reported assay values gave 0.01 percent Cu, 0.02 percent Zn, 0.005 ounce of Au per ton, and 0.03 ounce per ton Ag. Additional sulphide zones consisting of pyrite and pyrrhotite were intersected at lengths of 13.7 and 17.6 m. However, assay values for these intersections were less than those figures just given. In outcrops that occur near the diamond-drill hole site, assay values were reported at <0.003 percent Cu, <0.1 percent Zn, <0.003 percent Pb, <15 ppm Ag and <60 ppb Au. No further work was reported and the claims were allowed to lapse in September 1978.

Doyle Lake - South

In 1975, Geophysical Engineering Limited diamond drilled a hole 37.6 m in length on a previously undiscovered sulphide zone located approximately 1800 m south of Doyle Lake. The mineralized zone occurs in dacitic metavolcanic tuffs, strikes northwesterly, and dips steeply to the east. The sulphide zone is approximately 1.0 m across and is 365 m long along strike. Outcrops containing up to 30 percent sulphides were reported to occur near the drill hole site and gave assay values of <52 ppm Cu, <69 ppm Zn, 1.0 ppm Ag, and <20 ppm Au (see Table 8). The drill hole intersected the sulphide zone at a length of 24.3 m. The zone contained 50 percent pyrite and pyrrhotite as massive veinlets and disseminated grains within the tuffs. Assay values over a length of 1.0 m gave <47 ppm Cu, <209 ppm Zn, <1.4 ppb Au, and <20 ppb Hg. No further work was reported on the claims which were allowed to lapse in September 1978.

J.E. GIMBY [circa 1952] (4)

An occurrence of uranium was discovered by J.E. Gimby, *circa* 1952, approximately 300 m north of the northern bank of the Montreal River in the southwest part of McAughey Township. Two samples were submitted by Gimby for assay; one from a pegmatite which gave 0.063 percent U_3O_8 and one from a biotite gneiss which gave 0.081 percent U_3O_8. No further work was reported and the area is currently not held.

Grey Owl Lake Area

During the course of field work, the author attempted to locate this occurrence for additional sampling. A scintillometer (McPhar TV-1) was used during the investigation, and in several places readings well above background were obtained. A grab sample was taken by the author from a biotite gneiss at the west end of the Montreal River Fault on the northern bank of the Montreal River, and was submitted for assay to the Geoscience Laboratories of the Ontario Geological Survey. A value of 0.026 percent U_3O_8 was reported for this sample.

The radioactive zone appears to occur along a shear zone, that trends east and dips vertically. The shear zone is part of the Montreal River Fault. The fault zone is approximately 2000 m in length along the north bank of the Montreal River and is approximately 25 m in width. The zone is composed of intensely brecciated, fractured, carbonatized, and silicified mafic to intermediate metavolcanics and biotite gneiss; these rocks have been intersected by and fill the fault. North of the fault, numerous pegmatite dikes occur within the mafic to intermediate metavolcanics. The presence of the radioactive minerals is probably related to the development of the fault, but no visible radioactive minerals were observed in the field.

The Montreal River Fault is part of a major fault set related to the development of the Lake Superior Basin and the Kapuskasing Structural Zone. Radioactive occurrences are known to be associated with this fracture system in the Montreal River Harbour area (Ranwick Uranium Property). Additional work on this occurrence would seem to be justified in order to determine the extent and distribution of the mineralization for economic consideration.

RIO TINTO EXPLORATION LIMITED [1964] (5)

In 1964, Rio Tinto Canadian Exploration Limited took an option with the Algoma Central Railway to investigate previously discovered mineral occurrences and to locate additional ones. An extensive program was undertaken in which an airborne electromagnetic and magnetic survey, ground electromagnetic, magnetic and gravity follow-up surveys, geologic mapping, and trenching were carried out. Nineteen conductors were located by the airborne survey; 14 of these were investigated by ground follow-up surveys. Only six of these 14 conductors were trenched or investigated by the company to any extent (see Table 8).

Redcliff Lake

This "occurrence" is located at the southeastern end of Redcliff Lake, and has disseminated pyrite and pyrrhotite which constitute as much as 20 percent of the rock. The occurrence occurs in metasediments which strike northwesterly and dip to the northeast near the contact with the Grey Owl Lake Stock. The mineralized zone is approximately 100 m in length along strike and is less than 15 m across. A value of 0.02 percent Cu was reported in a trench 15 m wide. No further work was reported.

Doyle Lake, North

A sulphide zone approximately 600 m north of Doyle Lake was excavated by trenching. This trenching uncovered pyrite mineralization which varies from 5 to 75 percent by volume of the rock, and occurs within metasedimentary interbeds in the felsic metavolcanic sequence.

The mineralized zone is approximately 600 m in length and 6 m wide. This conductor is probably on strike with the sulphide zone to the north, which was diamond drilled by Canex Aerial Exploration Limited. The trenched section gave assays of 0.02 percent Cu over a length of 0.6 m and 0.02 percent Cu, and 0.01 ounce of Au per ton over a length 13.7 m. Two surface grab samples gave assay values of 0.1 percent Cu, 0.05 percent Pb, and 0.01 percent Zn. No further work was reported.

Doyle Lake, South of the Lake Shore

This "occurrence" is located approximately 150 m south of the eastern part of Doyle Lake, within felsic metavolcanic tuffs and intercalated metasediments. The mineralized zone strikes northwesterly and dips 40 to 70° to the northeast. Trenching indicated that the mineralized zone consists of pyrite and pyrrhotite, and is conformable with the bedding in two zones with up to 20 percent pyrrhotite over a distance of 10 m across the bedding. Assay values of 0.02 ounce of Au per ton over a length of 4 m were reported. These investigations yielded no indication of the presence of base metals. No further work was reported.

Doyle Lake, South

A sulphide zone consists of minor pyrite and occurs conformably within metasediments and felsic metavolcanics. This zone was located approximately 2800 m south of Doyle Lake. The zone strikes northward and dips 50 to 70° easterly. Additional sulphides were observed near the contact of a diabase dike having the same strike as the mineralized zone. Little information was reported, and no further work was performed.

Doyle Lake, South-Southeast

Pyrite is associated at the contact of a diabase dike with felsic metavolcanics that is located approximately 2800 m south-southeast of Doyle Lake. The conductor could not be traced for any distance and is possibly related to the intrusion of the diabase dike. No further work was recommended.

Grey Owl Lake - Southeast

A zone of pyrite mineralization approximately 0.4 m across occurs at the contact of a diabase dike and easterly dipping, northwesterly-trending metasediments. The contact occurs approximately 2400 m southeast of Doyle Lake. The zone is of unknown length and is near a fault that transects the sequence. Trenching was carried out over a width of 5 m across strike, and an assay value of 0.02 percent Cu was obtained. No further work was performed. This conductor appears to be within a large xenolith of metasediments within the Grey Owl Lake Stock.

Doyle Lake Occurrence (6)

The field party recorded the presence of numerous quartz veins during the course of mapping, one of which was sampled. This quartz vein is situated approximately 600 m southwest of Doyle Lake at the contact of the Grey Owl Lake Stock and the felsic metavolcanic tuffs. The quartz vein is rusty to smoky, approximately 1 m across, and intrudes both the quartz monzonite and the metavolcanics. The vein strikes east, dips 65 degrees to the south, and appears to have filled a shear zone that was formed after or at the time of the quartz monzonite intrusion. The vein consists of a large vein with many off-shooting stringers. A grab sample was collected by the field party and submitted to the Geoscience Laboratories of the Ontario Geological Survey. The sample yielded values of 0.54 ounce of silver per ton and traces of Au.

Other similar quartz veins within the map-area display the same colour and attitude, but were not sampled. Some of the quartz veins might contain significant amounts of gold or silver.

RECOMMENDATIONS FOR FUTURE MINERAL EXPLORATION

The felsic metavolcanics of the Doyle Lake area have received some attention from prospectors and exploration companies for base-metal potential. The metavolcanics of this map-area have been interpreted as a distal facies environment, and probably no nearby volcanic vent from which these rocks originated is in existence. Nevertheless, the map-area may still be geologically favourable for mineral exploration, particularly near the mafic-felsic contact of the mafic and felsic metavolcanics where coarser pyroclastic rocks were observed during field mapping. Eastward into Running Township, the metavolcanics may be more proximal, and may have more mineral potential. More detailed and sophisticated methods of exploration will also probably be required to determine the area's full economic potential.

The north bank of the Montreal River, in the vicinity of the J.E. Gimby [circa 1952] (4) property warrants further work to determine the actual extent of the radioactive mineralization. The radioactive mineralization is most probably related to the fracture network developed from the formation of the Lake

Superior Basin and Kapuskasing Structural Zone. These fractures and faults could become a target for further exploration. Further exploration may also focus on Late Precambrian related deposits such as the late felsite intrusives that occur at the Tribag Mine. Even though Late Precambrian volcanic rocks or felsite bodies have not been found in the map-area, undiscovered Late Precambrian rocks possibly may occur to the west or north of the map-area. This area is currently largely unmapped.

REFERENCES

Ayres, L.D.
1972: Guide to Granitic Rock Nomenclature Used in Reports of the Ontario Division of Mines; Ontario Division of Mines, Miscellaneous Paper 52, 14p.

Ayres, L.D., Lumbers, S.E., Milne, V.G., and Robeson, D.W.
1971a: Explanatory Text, Legend, Scale *for* Ontario Geological Map; Ontario Department of Mines and Northern Affairs Map 2196. Compilation 1970.
1971b: Ontario Geological Map, Central Sheet; Ontario Department of Mines and Northern Affairs Map 2198, scale 1:1 013 760 (1 inch to 16 miles). Compilation 1970.

Card, K.D., Church, W.R., Franklin, J.M., Frarey, M.J., Robertson, J.A., West, G.F., and Young, G.M.
1972: The Southern Province; p.335-380 *in* Variations in Tectonic Styles in Canada, R.A. Price and R.J.W. Douglas, Editors, Geological Association of Canada Special Paper Number 11.

Fisher, R.V.
1966: Rocks Composed of Volcanic Fragments and Their Classification; Earth Science Review, Volume 1, Number 4, p.287-298.

Giblin, P.E., and Leahy, E.J.
1967: Ontario Geological Map, Sault Ste. Marie - Elliot Lake Sheet; Ontario Department of Mines Map 2108, scale 1:253 440 (1 inch to 4 miles). Compilation 1964-1965.
1977: Geological Compilation of the Batchawana Sheet, Districts of Algoma and Sudbury; Ontario Geological Survey, Preliminary Map P.302 (1977 Revision), Geological Compilation Series, Scale 1:126 720 or 1 inch to 2 miles. Compilation 1974-1976.

Giblin, P.E., Leahy, E.J., and Robertson, J.A.
1980: Ontario Geological Map, Sault Ste. Marie - Elliot Lake Sheet; Ontario Department of Mines, Map 2419, scale 1:253 440 (1 inch to 4 miles). Compilation 1974-1976.

Green, J.C.
1977: Keewanawan Plateau Volcanism in the Lake Superior Region; p.407-422 *in* Volcanic Regimes in Canada, Edited by W.R.A. Baragar, L.C. Coleman, and J.M. Hall, Geological Association of Canada, Special Paper Number 16.

Gross, G.A.
1965: Geology of Iron Deposits in Canada, Volume 1, General Geology of Evaluation of Iron Deposits; Geological Survey of Canada, Economic Geology Report 22, 181p.

Grunsky, E.C.
1980: Geology of the Cowie Lake Area, District of Algoma; Ontario Geological Survey Report 192, 67p. Accompanied by Map 2426, scale 1:31 680 (1 inch to ½ mile).

Holland, T.J.B., and Norris, R.J.
1979: Deformed Pillow Lavas From the Central Hohe Tavern, Austria, and Their Bearing on the Origin of Epidote-Boded Greenstones; Earth and Planetary Science Letters, Volume 43, p.397-405.

Irvine, T.N., and Baragar, W.R.A.
1971: A Guide to the Chemical Classification of the Common Volcanic Rocks; Canadian Journal of Earth Sciences, Volume 8, p.523-548.

Jensen, L.S.
1976: A New Cation Plot for Classifying Subalkalic Volcanic Rocks; Ontario Division of Mines, Miscellaneous Publication 66, 22p.

Kamb, W.B.
1959: Ice Petrofabric Observations from Blue Glacier, Washington, in Relation to Theory and Experiment; Journal of Geophysical Research, Volume 64, p.1891-1909.

Mehnert, K.R.
1968: Migmatites and the Origin of Granitic Rocks; Developments in Petrology, Volume 1; Elsevier Publishing Company, Second Impression with Minor Modifications and Additions, New York, 1971, 405p.

Miyashiro, A.
1973: Metamorphism and Metamorphic Belts; George Allen and Unwin Limited, London, 492p.

Moore, E.S.
1925: Mississagi Reserve and the Goulais River Iron Ranges: District of Algoma; Ontario Department of Mines, Volume 34, Part 4, p.1-33, Accompanied by Map 34d.

Ontario Department of Mines-Geological Survey of Canada
1963: Hubert, Algoma District; Aeromagnetic Map 2203G, Ontario Department of Lands and Forests and the Department of Mines and Technical Surveys, Scale 1:63,360 or 1 inch to 1 mile.

Siragusa, G.M.
1975: Batchawana-Pangis Area (Western Half), District of Algoma; Ontario Division of Mines, Preliminary Map P.998, Geological Series, Scale 1 inch to ¼ mile, or 1:15 840, Geology 1974.
1976: Batchawana-Pangis Area (Eastern Half), District of Algoma; Ontario Division of Mines, Preliminary Map P.1193, Geological Series, Scale 1 inch to ¼ mile or 1:15 840, Geology 1975.
1978a: Quinn Lake Area (Western Half), District of Algoma; Ontario Geological Survey Preliminary Map P.1833, Geological Series, Scale 1:15 840 or 1 inch to ¼ mile, Geology 1976.
1978b: Quinn Lake Area (Eastern Half), District of Algoma; Ontario Geological Survey, Preliminary Map P.1834, Geological Series, Scale 1:15 840 or 1 inch to ¼ mile, Geology 1976.

Thurston, P.C., Siragusa, G.M. and Sage, R.P.
1977: Geology of the Chapleau Area, Districts of Algoma, Sudbury, and Cochrane; Ontario Division of Mines, Geological Report 157, 293p. Accompanied by Maps 2351 and 2352, scale 1:250 000 and Map 2221, Scale 1 inch to 4 miles (1:253 440).

Wanless, R.K.
1970: Isotopic Age Map of Canada; Geological Survey of Canada, Map 1256A, scale 1:5 000 000, Compilation 1969.

Winkler, H.G.F.
1976: Petrogenesis of Metamorphic Rocks; Springer Verlag, New York, 4th Edition, 334p.

Page

Abitibi Belt 5
Age dates. 5
  Isotopic. 41
Algoma Central Railway . . . . 56-68 *passim*
See also: Raaflaub Tp.; Runnals Tp.
Alvin Lake 7, 8, 11, 16, 31, 34, 38, 46, 62
Alvin Lake Synform. 8, 26, 27, 31-33, 46, 50 54, 58
Amphibolite facies metamorphism 46
Analyses:
  Chemical 7
    Diabase dikes 42-43
    Intrusive rocks 35, 40
    Metasediments 28-29
    Metavolcanics 12-14, 20-21
  Modal:
    Diabase dikes 42-43
    Intrusive rocks 35, 40
    Metasediments 28-29
    Metavolcanics 12-14, 20-21
  Trace element:
    Diabase dikes 42-43
    Intrusive rocks 35, 40
    Metasediments 28-29
See also: Assays.
Anatexis 46, 57
Arkose 30, 31
Asarco Expl. Co. of Canada Ltd. . . 61, 63
Assays:
  Copper 66-70
  Gold . . . . . 62, 65-70 *passim*
  Lead 67, 69
  Mercury. 67
  Nickel 67
  Silver 62, 67, 70
  Uranium 63, 67, 68
  Zinc 67, 69
See also: Analyses.
Assessment work table 59-61
Atomic Lake 54

Basalt, tholeiitic 8
Basin, Lake Superior 7, 41, 47, 50, 55, 68, 71
Batchawana Belt 5, 7, 34, 50, 54, 55, 57, 63
Bedding thickness in mafic units. 11
Buildingstone 65

Canex Aerial Expl. Ltd. 61, 63, 69
Chalcopyrite. 58
Chemical analyses 7
  Intrusive rocks 35, 40
  Metasediments 28-29
  Metavolcanics. 12-14, 20-21
See also: Analyses; Assays.
Clasts (metavolcanic) 32

Page

Contacts:
  Diabase dike - metasediments. 70
  Felsic intrusions-supracrustal rocks . . .7
  Felsic to intermediate metavolcanics - intermediate to mafic metavolcanics 18
  Felsic to intermediate metavolcanics - metasediments 18
  Grey Owl Lake Stock - felsic metavolcanic tuffs 70
Copper 62
See also: Assays.
Cordierite, pseudomorphs. 37, 47

Depositional environments . 19, 30, 31, 33
Diabase dikes 5, 41, 54, 56, 59
  Analyses 42-43
  Contact with metasediments 70
Dikes 41
See also: Diabase dikes.
Distal facies metamorphism. 56
Doyle Lake . . . . . .16-27 *passim*, 31-33, 39, 44-50 *passim*, 54-58 *passim*, 63-70 *passim*
Dyer Lake 54

East Lake. 34

Faults:
  Grey Owl Lake 25, 32, 47, 50, 55, 56
  Montreal River 7, 54, 55, 56, 62, 68
Felsic intrusions - supracrustal rocks contact. 7
Felsic metavolcanic tuffs - Grey Owl Lake Stock contact 70
Flow thickness 8
Foliation; definition. 50
Fragments, volcanic 17

Garnet. . . . . .16-27 *passim*, 32, 34, 46, 47
Geophysical Engineering Ltd. . . .61, 64, 67
Gimby, J. E.. . . . . .59, 63, 67
Glacial striae. 44
Gneissosity; definition 50
Gold 58, 62
See also: Assays.
Goulais River Iron Range 62
Granodiorite. 38, 41
Gravity high, mid-continent. 55
Greenschist facies metamorphism . . 44, 46
Grey Owl Lake 31, 32, 39, 41 47, 54
Grey Owl Lake Fault 25, 32, 47, 50, 55, 56
Grey Owl Pluton. 25
Grey Owl Lake Stock. . . 7, 19, 26, 27, 39, 47, 50, 55, 58, 62, 68, 70

Contact with felsic metavolcanic tuff. 70
Contact zone 41

Hematite 65

Ilmenite. 65
Intrusive rocks, felsic:
Analyses 35, 40
Contact with supracustal rocks. 7
Iron Range, Goulais River 62
Ironstone. 25, 62

Jalore Mining Co., Ltd.. . . . . 59, 63
Joubin, F. R.; and Associates. . . 56, 63-66

Kapuskasing Structural Zone 7, 47, 50, 55, 68, 71
Kenoran Orogeny 5

Lamb Lake. 34
Lithologic units: table 6

Mafic units:
Bedding thickness 11
Magnetite. 11, 25, 62, 66
Mallot Lake 7, 8, 17, 25, 26, 30-33, 46, 54, 56, 62, 64
Melanosome 36
Metamorphism 8, 16, 19, 26
Anatexis 46, 57
Facies:
Amphibolite. 46
Greenschist 44, 46
Distal; sequence 56
Grade increase 44
Metasediments:
Analyses 28-29
Contacts:
Diabase dike. 70
Metavolcanics 18
Thickness. 7
Metavolcanics:
Environment of formation 70
Felsic to intermediate:
Analyses 20, 21
Contact with intermediate to mafic metavolcanics 18
Contact with metasediments 18
Thickness. 18
Intermediate to mafic:
Analyses 12-14
Contact with felsic to intermediate metavolcanics 18
Sequences 8
Marker horizon 57
Migmatites 27, 34, 57
Modal Analyses:
Intrusive rocks 35, 40
Metasediments 28-29
Metavolcanics 12-14, 20-21
See also: Analyses; Assays.
Montreal River . . . . . 7, 8, 11, 16-39 *passim*, 44, 46, 47, 50, 54-58, 62, 63, 67, 70
Montreal River Fault 7, 54-56, 62, 68
Montreal River Harbour 62
Monzonite, quartz 38, 39

Neosome 36, 38

Paleosome 36
Pleistocene Epoch 5
Pyrite 11, 58, 62, 64-69
Pyrrhotite 58, 62, 66-69

Quartz, veins 64, 70
Quartz monzonite 38, 39

Raaflaub Tp. 56
Redcliff Lake 62
Rio Tinto Canadian Expl. Ltd.. . . . 61, 63, 64, 66
Runnalls Tp 56

Schistosity, definition of. 50
Siegal, H. C.; and Associates . . . 63, 64, 66
Silver 58, 62
See also: Assays.
Staurolite. 26, 27, 47
Striae, glacial 44
Structural zones 47
Sulphide minerals:
See: Chalcopyrite; Pyrite; Pyrrhotite.
Superior Basin, Lake 7, 41, 47, 50, 55, 68, 71
Superior Province 5
Supracrustal rocks - felsic intrusions contact. 7
Syncline 18
Synform, Alvin Lake . . . 8, 26, 27, 31, 32 33, 46, 50, 54, 58
Technical Mine Consultants. 59, 63
Tholeiite, high iron 43
Tholeiitic basalt 8
Top determinations 54
Trace elements analyses:
Diabase dikes 42-43
Intrusive rocks 35, 40
Metasediments 28-29
See also: Analyses; Assays.
Trondhjemite 38, 57

Union Lake . . . 25, 26, 27, 31, 32, 33, 54

Veins, quartz 64, 70
Volcanic cycle 5
Volcanic fragments 17

Wackes 30, 31

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